No. 5

MEMOIRS

OF THE

KYANCUTTA MUSEUM

Kyancutta, South Australia

An Outline of "Biosophy"

(PART I.)

By

R. Bedford

FEBRUARY 1938

Memoirs of the Kyancutta Museum

No. 5 **Kyancutta, South Australia** *February, 1938*

AN OUTLINE OF "BIOSOPHY" (Part I.)

BY R. BEDFORD

CONTENTS OF PART I.

INTRODUCTION.

1. My reason for using a new name, "*Biosophy*" (Wisdom of Life) for the following outline is that I have in view a certain scope of subject, a certain method of treatment, and certain aims which may best be defined under a new name as a distinction from names previously used for writings which, while having many points of resemblance, have sufficient difference either in scope, treatment, or aim to render their use for the present study misleading.

2. Let me say at once that the attempt of this work is too ambitious to make anything more at first than a crude, unbalanced outline possible, for me at all events, and that my justification for writing it is not so much in the small amount of original work it contains, or in saying things again which more capable writers have already said before, but in the fact that whereas a minority of people will probably agree in the main with its point of view, it is certain that the great majority still base their conduct on entirely different assumptions.

3. The aim of Biosophy is to bring together the main generalisations of the sciences, particularly those which concern man's place in Nature and his future possibilities, and to base thereon a rational plan of living and a right scheme of economic, political, and international relations. This aim assumes that for every question that may be put there is one true answer, and that to obtain this true answer it is necessary to face the question honestly and to clear away from it all entangling falsehoods and prejudices. Although no one would claim that science has reached finality in fundamental principles, it may nevertheless be claimed fairly that enormous progress has been made, and, which is most important from our point of view, it is certain that the world in general lags far behind the advanced knowledge of our time, and that the abuse of the practical discoveries of science is fully as marked as their rational use. There is need to crystallise and popularise the scientific outlook and to make it serviceable for the best use of humanity, and Biosophy aims to do this. In brief, Biosophy is the Science of Life and the Art of Living.

4. In its method Biosophy is to a large extent a series of laboratory sciences, but it must also be founded on research in social and international fields. It thus envisages the co-operation of research specialists and more or less extensive publications of more or less technical nature. But even more important for utility and effectiveness is the preparation of a manual of Biosophy in a form readable by the average intelligent and fairly educated man. Such a manual should be in the nature of a universal institution and should be constantly improved, re-written, and brought abreast of current knowledge, in the form of a single moderate-sized volume, as a scientific guide to mankind in the things that really matter.

5. Biosophy, as I am introducing the term, negatives the existence of a god or providence and the survival of the human personality after death, and regards the ideas of such as untrue, and therefore to be actively combated and not merely ignored; it regards natural science as the only and sufficient guide to man, and mankind's destiny as dependent solely on his own knowledge and on his own reactions to his environment. In the unlikely (I would say impossible) event of a god appearing or of human personality being proved to survive death, then Biosophy would cease to exist as a science. I consider that the conception of life and consciousness as a function of molecular complexity, as partially developed in my second and third chapters, agrees sufficiently with known facts to be accepted as disproving the possibility of god or human survival after death.

6. The scope of Biosophy is as extensive as its aim. It calls on the sciences for description of the Present and for elucidation of the Past; above all, it plans action for the Future. The highest achievement of every science and every art lies in its contribution to Biosophy: and in return Biosophy will be the inspiration of conduct, economics and politics, and the dominant consideration in our education and in the planning of our libraries and museums. Can it be denied that there is urgent need of such a unifying science and art and that such may best be developed under a new name? No similar movement, under whatever name, has yet made anything approaching the universality of appeal or the speed of progress which the conditions of our modern world call for and which Biosophy may fairly expect to make if it is developed with sincerity. In a few years the use of scientific inventions spreads throughout the world—for example, motor cars, aeroplanes, wireless—why should not the influence of scientific investigation into human conduct be spread with equal rapidity?

7. Of all men who have influenced the present generation in the direction of Biosophy the name of H. G. Wells comes first to mind. Mr. Wells, indeed, might object to being labelled as a Biosopher, and in one respect I would not claim him as being one; if he should see this instalment of an "Outline of Biosophy" I shall be greatly interested in having his opinion and comments thereon. His books will certainly be on the shelves of every Biosopher, as they are on mine, and his great trilogy, the "Outline of History," "Science of Life," and "Work, Wealth and Happiness of Mankind" goes far towards the dissemination of our science. There is one side of Biosophy to which I think Wells has not yet given much attention, viz., atomic physics: and one would welcome his treatment of this and related subjects. In connection with his economic and political surveys I have an impression that Wells is to some extent under the influence of his city environment of centralisation and elaborated, specialised culture, and that he hardly appreciates the importance and the potentialities of life in the more open spaces, life which in the aggregate is of equal importance with that of the great centres: if this is so Wells is not alone in being under such influence, for nearly all literature and publicity and nearly all political and financial control emanates to an ever-increasing degree from the great centres of population, with adverse effects on the well-being of outlying peoples which it will be one of the purposes of Biosophy to investigate and remedy. But the main reason which would make me hesitate definitely to claim Wells at present as a Biosopher is the streak of supernaturalism in his mental make-up. His "fantastic and imaginative romances" are a remarkable and very readable blend of science and the supernatural; stories of this kind, for example, Stevenson's "Dr. Jekyl and Mr. Hyde," and Barham's "Leech of Folkestone," are favorites of most of us, and such stories of Wells as "The Door in the Wall" and "The Magic Shop" have an eerie beauty which takes us willy nilly out of the world of reality; but one has to keep a firm hold on oneself to avoid confusing fiction with reality, and however lovely and desirable a fiction may be, that gives it no shadow of a claim to actual truth.

8. In "God the Invisible King" Wells seems to me to have definitely confused fiction and fact; had he given the reader any hint that God the Invisible King was a fiction, an allegorical personification of a unifying and progressive purpose in humanity, the book would have been excellent, and it is still excellent if the reader takes Wells' God as an allegory. But Wells' God is no allegory; he is "a god of salvation, a spirit, a person, a strangely marked and knowable personality, loving, inspiring and lovable, who exists or strives to exist in every human soul." "He is a Being, not us but dealing with us and through us, he has an aim, and that means he has a past and future." "God comes we know not whence, into the conflict of life. He works in men and through men. He is a spirit, a single spirit and a single person; he has begun and he will never end. He is the immortal part and leader of mankind. He has motives, he has characteristics, he has an aim. He is by our poor scales of measurement boundless love, boundless courage, boundless generosity. He is thought and a steadfast will. He is our friend and brother and the light of the world." Wells bases his belief in the reality of his God on the sole fact that a conviction of this has come to him as well as to some other people he has known; he says, "In the case of all those of the new faith with whose personal experience I have any intimacy, the idea of God has remained for some time simply as an idea floating about in a mind still dissatisfied. God is not believed in, but it is realised that if there were such a being he would supply the needed consolation and direction, his continuing purpose would knit together the scattered effort of life, his immortality would take the sting from death. Under this realisation the idea is pursued and elaborated. For a time there is a curious resistance to the suggestion that God is truly a person; he is spoken of preferably by such phrases as the Purpose in Things, as the Racial Consciousness, as the Collective Mind." "Then suddenly, in a little while, in his own time, God comes." Wells regards his creed as spreading irresistibly. "It is a Mountain of Light, growing and increasing." "It overleaps all barriers; it breaks out in despite of every enclosure. It will compel all things to orient themselves to it." "It is the Kingdom of God at hand."

9. In a chapter of his book headed "The Religion of Atheists" Wells quarrels with Metchnikoff, Joseph McCabe, Chalmers Mitchell, Gilbert Murray, and Sir Harry Johnston, apparently because they have not found his "God the Invisible King." Wells' auto-conversion to his new creed seems to have taken place between 1908, when he published "First and Last Things," and 1917, the date of "God the Invisible King." The period of the war and after has been one of such insensate folly in human affairs that one can almost understand a man feeling the hopelessness of trusting to human reason, longing for supernatural guidance, and slipping insensibly from the creation of a pleasing fiction to

belief in its reality. But compromise in the direction of the supernatural is no longer possible and the only way to make the life of mankind worth living is for man to concentrate his own energies on the task, discarding all reliance on supernatural aid or encouragement.

10. The present attempt at an "Outline of Biosophy" is a tentative draft and more or less haphazard in its arrangement and method of treatment, in part original, in part quotation from popular writers, in part notes from research papers; it is for the moment addressed rather to students, scientific workers, and economists, for the purpose of stimulating discussion, than to the public, although the treatment of most subjects will be so elementary that I must apologise to experts and ask their leniency in that respect. If and when a version is addressed to the public the question of language and terminology will have to be considered. This is a question which is becoming of increasing importance and difficulty in the whole field of science; not only is the breach widening between the world of science and the ordinary man by reason of the increasing elaboration of terminology, but the specialist in one branch of science is becoming with difficulty intelligible to the specialist in another. Setting aside the matter of terminology between specialists, which is a matter for themselves, that of treatment and vocabulary on the part of one addressing the general public requires careful consideration, and deserves a chapter to itself in this Outline. I do not know to what extent consideration has already been given to this; in this, as in many other questions, an aim of Biosophy will be to get in touch with what has already been done. Whereas technical knowledge has spread to a considerable extent to the public—most men are now fairly expert motor mechanics—I should say that the gap between scientific workers and the public as regards things that matter in Biosophy is greater now than it was in Victorian times; for one thing, scientific specialisation is more elaborate, for another, the distraction of trivial interests is greater among the public. The same problem is pressing upon the scientist, the economist, the librarian and the museum director, viz., to reach the public with the things that matter. The remedy appears to have two sides; one for the scientist to decide on and constantly revise a minimum vocabulary, a minimum which shall be within the grasp of the man of ordinary education; the other for that minimum vocabulary to be a part of the standard school curriculum.

11. A similar and equally important problem which will have to be considered in this Outline is the amount of mathematical knowledge essential for the ordinary man if he is to follow the progress of science. The problem will have to be treated in the same manner as that of vocabulary.

12. Bibliography will be an essential part of this Outline: looked at in the broadest sense the Bibliography of Biosophy is to a large extent synonymous with the Bibliography of "Books that Matter."

13. In attempting to define and classify the sections or subdivisions of Biosophy only a provisional classification is for the moment possible. One has to feel one's way towards such a classification, and whatever may be adopted at first is sure to be altered and re-altered as the work progresses. In systems of classification of all kinds not only are there difficulties in logical method of construction, but also, if a single logical method were possible (and usually it is not), considerations of practical convenience often interfere. Take, as a parallel example, the arrangement of a zoological museum; starting (as many of them have done) with a linear and logical arrangement of the animal kingdom in its phyla, classes, orders, families, genera and species, other modes of arrangement begin to encroach on the linear series and space is found for the comparative anatomy of organs, for demonstrations of heredity, variation, protective coloring, and the like; then habitat groups appear, and extinct forms are brought in and arranged both on a chronological and phylogenetic system; spirit specimens are stored separately for convenience and fire-protection; study collections are removed to workrooms for the use of specialists; year by year the arrangement changes, no one logical system dominates, and there is unavoidable overlapping and compromise. Similar fluctuation and compromise may be predicted for the classification of Biosophy. The main headings of Biosophy fall under Present, Past, and Future, although even here the order cannot be strictly adhered to and there will be some overlapping.

A. *Present.* Knowledge and Matter. The Universe. Life and Consciousness as a function of Chemical Complexity. Elimination of the Supernatural. Animal Life. Man's Place in Nature. Races of man. Health and Disease. Psychology of Man. Happiness. Sex and the Family. Social Relations. Government. War. Population. Education. Literature, Art and Music. Sport and Recreation.

B. *Past.* Evolution of Man. Prehistoric Man and Early Civilisations. History.

C. *Future.* Utopias and Forecasts. Eugenics. Rationalisation of Industry. Rationalisation of Law and Government. Reform of Language. International Co-ordination.

D. *Vocabulary* and Bibliography and Source-Books of Biosophy.

14. Biosophy lays no claim to be higher than the specialist sciences or to control them; rather it asks the specialist to remember the shortcomings of the ordinary man and at times to write down to his level, and it asks the specialist to be a Biosopher as well as a specialist. The Biosopher is, in the popular side of his work, so to speak, an Editor, saying to such and such a specialist, "I can give you twenty pages and half a dozen plates, will you do the best you can to present your subject, using for the purpose our standardised vocabulary?"

15. Biosophy is not concerned with the details of Technology, although such detail may occasionally be used as an illustration of economic or political principle,

It is not concerned with systematic Zoology, excepting as regards the main line of evolution of Man, and the establishment of biological fundamentals.

16. It aims at balancing evenly the claims of Cultural and Economic considerations, and regards Truth in the form of high intellectual interest, Beauty in Art and healthy activity in Recreation as in no way losing importance because they or either of them do not contribute directly to the satisfaction of such material needs as food and clothing; or because they do not facilitate commercial or political exploitation.

17. In its outlook Biosophy is optimistic and Utopian. It regards Truth, Beauty, Liberty, Health, and Equity as the foundations of Happiness; and rational Happiness as the greatest good. It sets itself against the exploitation of individual by individual or of class by class; and also against the exploitation of the residents of one area by the residents of another. It stresses the importance of the conception of "Optimum Population" as applied to every unit of area, and will probably regard birth-control and eugenics as practicable means of securing such optimum; by "optimum" is meant that quantity and quality of population which ensures for the whole the best and highest standard of living attainable at the time, and from time to time. It resists any claim by aggressive powers deliberately to foster over-population in their territories as an excuse for forcible occupation of other and sanely-populated countries. It studies the racial characters of mankind with sincere desire to arrive at the truth with regard to the desirability or otherwise of certain racial crossings, and with the intention of adjusting racial problems on the lines of truth so arrived at and with justice to the races concerned. It views with abhorrence the social inequality and injustice which is glaringly evident to-day, studies dispassionately the individualist and socialist standpoints and seeks a remedy which it may perhaps expect to find in a middle course. It may safely be anticipated that Biosophy will insist on better conditions for children and more equal opportunity for youth; that it will deprecate disproportionate rewards and powers going to entrepreneurs and schemers as compared with workers, will put drones and parasites in their proper places, will abolish or greatly diminish rates of interest, will handle questions of land tenure on rational and equitable lines, and, at least in countries requiring population, will endow motherhood.

18. Needless to say, Biosophy will study closely the causes of War and will do all in its power towards prevention. An insufficiently-recognised cause of war is the general toleration of the "exploitation of place by place"—of country by town, colony by mother country, weak country by strong. So long as this is tolerated *within* countries and empires, so long will *outside* aggression and exploitation be sought; the rights of the small internal units of area should be recognised as a preliminary towards those of the large external units.

19. The main need and justification for Biosophy lies in the interdependence of all these questions of social relationship and their origin in the fundamentals of physical and biological science and psychology; a general survey is a necessary preliminary to specialised treatment by experts. In the absence of such a general survey, the specialised discussions may well be too technical and confusing for the general reader; added to which, in economics and politics, there are fundamental differences among the various experts which it is very difficult for the layman to disentangle.

20. Biosophy aims at a humanistic universality of appeal, and at establishing a common ground of knowledge and a common code of ethics which may serve to unite men and women of all races and all nationalities and help them towards the realisation of the finer life which science has made possible. The acceptance of a scientific code in human affairs offers the only chance of using instead of abusing the practical gifts of science. The need of such a rational ideology, disseminated to become the common possession and motivation of humanity, must be obvious to all Biosophers. I think it is no exaggeration to say that we have no confidence that at this moment the destinies of the British Empire are not being decided by the visit of one of our "statesmen" to a palmist; that the cause of Labor is not being betrayed for a generation because one of its leaders has to make good his losses at the last race meeting by accepting the easiest money offering; that some country is not on the verge of civil war because of squabbles between bishop and royalty over the latter's love affairs; or that world war and collapse of civilisation are not pending through some imaginary racial superiority of Nordic or Mongolian. Whatever Biosophy can do to destroy the illusions of the superstitious, the gamblers, the conventional and the prejudiced, and to remove the victims of such illusions, no less than the victims of drink and dope, from the control of world affairs, will be work well worth doing.

21. Among the anticipated publications of Biosophy for the general reader I have already referred to a single volume "handbook," presenting an outline of the whole subject. This would be supplemented by the expansion of each of several chapters into a separate volume or "text-book," giving a reasonable and necessary amount of detail, each volume written by an expert and well illustrated, but still addressed to the public and using the recognised vocabulary of Biosophy. As the text-books gradually come to be written, they will form a compact and serviceable popular library of Biosophy, and will avoid nearly all overlapping and duplication in treatment; they will be adequate in scope and detail and at the same time readable without undue difficulty. Fifty volumes of this kind would be more useful than five hundred of the unco-ordinated, difficult, overlapping volumes we are accustomed to. In the meantime, until the fifty volumes of Biosophy are written, we have to find our way as best we can among the five hundred or so most serviceable ones we can select from the countless volumes of existing literature.

22. The "Handbook" of Biosophy should be familiar to every elector in a democracy, and the "Textbooks" to everyone concerned in education and

government, in the newspaper press, radio, and the cinema.

23. It may be considered that I am concentrating too much on Biosophy as a book subject. I think, from the point of view of reaching all the people all the time, this is unavoidable. We must not, however, lose sight of other points of view. First there is the laboratory side; a small amount of elementary science is already taught as a laboratory subject even in primary schools, and this is capable of considerable extension; but anything in the nature of adequate laboratory presentation of Biosophy means more time than the average student can spare and more expense of teachers and equipment, if the whole of the public is to benefit, than seems at present practicable; this difficulty is present even in the great centres of culture, and in remote, sparsely settled districts, which, after all, collectively are of at least equal human importance with the great centres, it becomes almost insuperable. Books, on the other hand, can reach everyone at comparatively negligible cost; and a book is always there to be read or referred to.

24. Of permanent institutions for the promotion of Biosophy, next in importance after the primary school comes the public free library, for there is nothing to prevent the development of an adequate library, including a library of Biosophy, even in the most remote country centres. Museums also are capable of being developed to give an adequate presentation of Biosophy, and by the exhibition of scientific apparatus and reproduction of experiments, could come very close to taking the place of laboratory work; small educational museums are by far the least expensive means of bringing science before the public in a practical, tangible form, and are capable of being established in remote districts, where they will be in their sphere of influence of equal value with the large city institutions. Supplementary to the permanent equipment of school, library and museum, very valuable use, from the biosophical point of view, may be made of educational films in the cinema, and educational talks on the radio; nor should it be forgotten that, besides such "educational" work, a high cultural standard in drama and music in the normal programmes is of equal importance to the Biosopher.

FREE WILL.

25. I think that Biosophy will be based on the assumption that our *will* is free. An imposing array of data can be assembled in contradiction of this; it may be granted at once that our *powers* are strictly limited by the "laws" of Nature and that we can only do things in accordance with those "laws." In many cases, when we think we act deliberately and of free will, it can be shown that circumstances and conditions in relation to our particular character have had much more part in determining our "choice" of a line of action than we ourselves realise. This is well shown in statistics of human action, where, even if it would be difficult to forecast the precise behaviour of an individual, one can safely forecast the percentage of a large group which will act in a particular way. For example, I could hardly say myself if I shall pay a tax before or on or after its due date, but the taxation department knows fairly well what percentage of its victims will call on each particular day over a period. I do not know if I shall spend Sunday on the beach or in the hills or in the art gallery, but the caterer at each of these places has a good idea, according to weather and season, how many visitors to provide for.

26. According to the degree of certainty with which a result can be expected from given conditions, we may distinguish three series of cases, characterised respectively by *Necessity*, *Chance* and (?) *Free Will*.

27. A. As an example of the first, if I fill a bottle with a mixture of two volumes of Hydrogen to one of Oxygen and apply a match, an explosion will follow. However many times I repeat the experiment (so long as I do not bungle my preparations) the result will be the same. The "laws" of nature are followed inevitably.

28. B. As an example of the second, you and I each have fifty pounds and we agree to stake the whole of this amount on the result of once tossing a penny. According as it comes down "head" or "tail" one of us will lose all his money to the other. There is no certainty which will win; it is an "even chance." The bare statement, however, needs some qualification; if the precise speed, direction and spin were known with which the penny left the tosser's hand the result could be foretold with some degree of certainty; indeed, if a machine were constructed with extreme accuracy and used to toss the penny, and its mode of action carefully tabulated, it is quite likely that it could be made to throw "heads" or "tails" at the owner's wish. In other words, if the conditions were more perfectly known, Necessity might be found to take the place of Chance. It is further to be noted that, using the crude method of tossing the penny, Chance gives place to an increasing degree of Certainty when a large number of throws are made. When you and I risk our fifty pounds on a single throw it is an "even chance" which wins; but if we made 12,000 throws and had a penny bet on each throw, it would be very surprising if we did not each end up within a few shillings of keeping his own fifty pounds. The result in a large number of cases considered statistically is practically as certain as was the result in our first example; it is an instance of "statistical law" in the mass covering "uncertainty" in the individual case. It is important to remember that recent discoveries and theories in atomic physics indicate that some of our "natural laws" may really be "statistical laws," individual uncertainty in the behaviour of particles being masked by statistical certainty in the average behaviour. For example, in a small mass of radium the number of particles thrown off in a second and the average "life" of a radium atom may be known exactly, but the knowledge is statistical and there appears

to be complete uncertainty as to when a particular individual atom will disintegrate.

29. C. Finally, we have to look for an example of our third case, viz., Free Will. The question we have to answer is, when you or I consider two alternatives as to a proposed action, is our decision an exercise of deliberate choice, i.e., of Free Will, or is it in reality forced on us by preceding circumstances? i.e., if anyone knew precisely the whole of these circumstances could he foretell with certainty what our action would be? Is Free Will, which most of us *think* we have, really an illusion, and does Necessity really govern us, or, as a further alternative, does Chance come in part upon the scene? Suppose that a man, on holiday, takes a walk along a country road which is quite unknown to him; the road ends in a T, with branches leading left and right. Which road will he take? Suppose also that an observer made it his business, hidden behind the hedge, to tabulate the actions of all the solitary holiday-makers who come to this cross-road. He might find statistically that 50% of his men went one way and 50% the other; on observing more closely he might find that all the 25% of tall fair men, apparently attracted by a distant glimpse of the sea, took the lefthand road; all the 25% of short dark men seemed to be drawn by a group of pine trees and took the righthand road; the remaining 50% took either road indiscriminately for all the observer could see. From the observer's point of view he would conclude that there was a Statistical Law by which it could be foretold that 50% would go to the left and 50% to the right; that this Statistical Law covered 25% compelled by Necessity to go one way, and 25% compelled by Necessity to go the other; whilst, of the remaining 50%, although the Statistical Law held good, no prediction could be made as to the action of any one individual; but the observer would be at a loss to know whether Chance or Free Will was the leading factor in each of the latter 50% of cases. If one asked each of the individual holiday-makers why he took the particular road, one would probably find him under the impression that he had taken it from choice, i.e., with the exercise of his free will; the observer, on the other hand, would tend to be rather sceptical as to this.

30. The above example has left us rather undecided as to the existence of Free Will, which is only to be expected, as the question has exercised the minds of philosophers for generations. Let us, therefore, examine one or two points connected with Free Will a little more closely. The exercise of Free Will (if such exists) in an action, implies directly and primarily only an infinitesimal transfer of energy (if any at all). When our holiday-maker decides to take the lefthand road, it is not his Free Will that does the work of carrying his body along that road, the work is all done by chemical (or we should now say electro-magnetic) agencies whose workings are now accounted for or are rapidly being accounted for to the uttermost farthing. When the captain of a battleship "wills" to fire a broadside, enormous power is released by an ounce or two of pressure on a button, and even this ounce or two is accounted for on scientific laws by the physiological processes of the firer's body. All that we need postulate for the exercise of an act of free will is the diversion of, it may be, one electron in the actor's brain, by an infinitesimal amount from its former course. Even that is probably a crude overstatement of the case from the energy point of view, because the whole tendency of modern physics is to show that our mechanical picture based on the behaviour of visible and even microscopical particles breaks down entirely in the inconceivably minute world of atom and electron. We know these things exist, but we cannot represent them by a mechanical model such as we use for the greater world.

31. It has already been pointed out that some "laws" are now known to be "statistical laws"—true in the mass, but untrue as to the individual particle, whose precise conduct can *not* be predicted. It may be suggested that this uncertainty, appearing in this form in the simple atoms of matter, may, in the enormous molecular complexes of living organisms, manifest itself as Free Will. Uncertainty in the behaviour of the constituents of simple atoms only affects the comparatively limited sphere of those simple atoms and is quickly masked by "statistical law." But uncertainty in the behaviour of a constituent of the living organised complex may be expected to have much more far-reaching effects, because it has a much larger *organised* field to work on. One unit of *uncertainty* may thus leaven the whole mass, as far as the organic linkings of the organism extend. A hundredweight of iron may contain within itself countless myriads of infinitesimal uncertainty units of which the effects are smoothed out by statistical law; whereas a hundredweight of man may at any instant be under the control of one such infinitesimal uncertainty unit, a control which perhaps manifests itself as Free Will.

32. In this connection the chapters which follow, "on Life and Consciousness as a function of Chemical Complexity," may be referred to.

33. The word usually employed in science for events under the rigid control of Natural Laws is *Determinism*, and for the reverse *Indeterminism*. I have rather avoided these words because, as so often happens with regard to words, they have a popular usage with a very different meaning. The words Determined, Determination are the same in origin as Determinism, but when we speak of Napoleon as being determined, as being a man of iron will and determination, we are using the terms to suggest Free Will in extreme form, and in precisely the opposite sense to the "determinism" of the scientist.

34. *Determinism* corresponds to Necessity. *Indeterminism* includes Chance (which may be masked by Statistical Determinism) and (?) Free Will.

35. If Biosophy accepts Free Will, as I think it may, at any rate as a working hypothesis, it does so on the following considerations, viz., that recent advances in Physics are more favourable that otherwise;

that we have a fairly strong conviction in ourselves of its reality; and that the contrary supposition, that we are automata, that free will is an illusion, and that our actions are either predetermined or the result of chance, is a very unsatisfactory and unworkable one. Perhaps overmuch importance should not be given to the latter consideration, because, even if we were all convinced theoretically that fate or chance ruled supreme, it would probably make little difference to our actual life and happiness; we should carry on in much the same way, just as the majority of people who believe in a future life show little sign of the belief in their daily conduct. If we accept the reality of Free Will, I do not see how we can avoid considering the rudiment of such as being an inherent property of matter.

36. I do not think we shall get much help towards a decision from historical views on the subject. The early Greeks do not appear to have worried themselves in the matter, but to have taken freedom of the will for granted. Probably they gave more power to the will than any of us would give today, now that we appreciate the limitations of natural law under which it has to work. The Epicureans seem to have been on the side of free will, the Stoics on the side of determinism: here, as in other matters, the Biosopher may feel more in sympathy with the Epicureans, although it may be noted that Winwood Reade, whom I should claim as a Biosopher, had, in these other matters, a leaning towards the Stoics. Christian Philosophy appears from Augustine onwards to have been dominated by "predestination" (=determinism), and either to have believed in the abominable doctrine that each human being was born irrevocably to either damnation or salvation respectively, the former to be tortured forever because they necessarily follow their destiny, or else to have believed that all since Adam were born to damnation, but a select few redeemed by the vicarious sufferings of Christ and the capricious grace of God.

37. Much in the same way as theological dogmas of the omniscience and omnipotence of God encouraged in the churches belief in predestination, so the increasing appreciation in the nineteenth century of the validity of natural laws encouraged belief among scientists in determinism as regards human action. Many, perhaps the majority, considered man as being a "conscious automaton." This view is strongly expressed in his book "The Service of Man" (1903) by the rationalist, James Cotter Morrison. "The doctrine of determinism," Morrison says, "is now so generally accepted that it will not be needful to dwell upon it at any length here. The cumulative argument in its favor, says Mr. Sidgwick, is so strong as almost to amount to complete proof." In support of his contention, Morrison stresses the importance of inherited quality, and also of education and habits in determining man's actions. "A man with a criminal nature and education, under given circumstances of temptation, can no more help committing crime than he could help having a headache under certain conditions of brain and stomach." Now, I fully admit the force of this and a number of Mr. Morrison's other arguments up to a point, but the question is whether there is a point beyond which they do not carry us, the point where free will actually comes into the picture. [In parenthesis Mr. Morrison's "criminal" is not a happy illustration. In our crazy world who *are* the criminals? Mr. Morrison himself was no doubt a criminal for the orthodox, and, had he lived no great number of years earlier, would have been lucky to escape the stake for his writings]. But a more important question is, did Mr. Morrison seriously and fully believe that from his heredity and environment he was irrevocably destined to write "The Service of Man" word for word as it appears, and that anyone with full knowledge of that heredity and environment could have predicted the same? Mr. Morrison's case illustrates a remark I made a few paragraphs earlier, as, in spite of being a confirmed believer in determinism, he lived a full and useful life in the Service of Man, so that evidently his belief was no detriment as regards his conduct and happiness.

38. However, I think modern physics allows a loophole for Free Will which was not foreseen in the nineteenth century, and to admit free will presents no greater difficulty than to admit consciousness, and that we all admit. Free will and consciousness are almost equally strong convictions of our minds; the former, after allowing all necessary qualifications, cannot well be dismissed on any evidence we have, and it appears to me to afford a more satisfactory and more coherent basis for human conduct than the alternatives of either sheer determinism or chance.

SOME FORERUNNERS OF BIOSOPHY.

93. Biosophy being essentially a bringing together of Natural Science, Philosophy, Ethics and Politics as a base for human happiness and progress, I only include in this note on some forerunners of Biosophy those writers who have combined two or more of these groups of studies in a single work. Of course, the original investigators of single subjects are of far more importance, seeing that they have provided the essential foundations on which Biosophy must build; but that is a different matter.

40. The first book I refer to is, "*Vestiges of the Natural History of Creation*," originally published anonymously in two volumes, dated respectively 1843, 1846, and acknowledged later as being the work of *Robert Chambers* (1802-1871), the well-known author and publisher. I have not the original edition at hand, the copy I quote from being the tenth edition, of 1853, in one volume. Although Chambers speaks of God, he regards him only as the original creator of the universe, in which natural laws were established at the creation and there has been no further interference on his part. Realisation of the unorthodoxy of this point of view caused Chambers to publish his book anonymously. After an astronomical introduction, Chambers gives an account of the formation of the Earth and of

the succession of geological periods and their fossil remains; he proceeds to general and particular considerations of the origin of the various tribes of animals and to a hypothesis of the development of the vegetable and animal kingdoms; then he gives a description of the affinities and geographical distribution of organisms; he regards man as developed from an ape-like ancestor and gives an account of the early history of mankind; there follows a section on the mental constitution of animals, and the book concludes with a review of the "purpose and general condition of the animated creation," in which consideration of human history and progress predominates. He says, "These improvements, then, thus partly wrought out by the exertions of the present race, I conceive as at once preparations for, and causes of, the *possible development* of higher types of humanity,—beings less strong in the impulsive parts of our nature, physical nature giving less matter for that nature to contend with and subdue to its needs,—more strong in the reasoning and the moral, because there will be less of the opposite to give these marring or check—more fitted for the delights of social life, because society will then present less to dread and more to love."

41. Chambers was an accomplished geologist, and has an important place as one of the founders of evolution. A single sentence in the "Vestiges" will suffice to show his breadth of view:—"The inorganic has been thought to have one final comprehensive law, *gravitation*. The organic, the other great department of mundane things, rests in like manner on one law, and that is *development*."

42. "Vestiges of the Natural History of Creation" is admirably written, and is still well worth reading. The 1853 edition has over a hundred most excellent illustrations of living and fossil animals. These appear to be originals, as no other source is given for them, and so well are they chosen that they, or nearly identical copies, are still to be recognised in recent text-books of zoology and geology.

43. Although Chambers' book has long been out of print it has left a lasting mark on the educational presentation of zoology and palaeontology, but I do not think it has much influenced politics. Biosophy could not have existed much earlier than the time of this publication, as it presupposes acceptance of evolutionary and dynamic principles in human affairs, an advance in organised science and a freedom of thought which were then as a whole becoming for the first time possible. I think, therefore, that the "Vestiges" may perhaps be considered as the first handbook of Biosophy; its wide scope, its unified outlook and its clear treatment and wealth of pictorial illustrations, may well serve to some extent as a guide for future handbooks.

44. *Karl Marx* (1818-1883), the author of "*Capital*," presents a very different picture from that of the writer just mentioned. This work is a combination of Politics and Philosophy, but it has a substratum of Science; Edward Bernstein refers to his scientific studies and says, "The great scientific achievement of Marx lies . . . in the *details* and yet more in the *method* and *principles* of his investigations in his *philosophy of history*. Here he has, as is now generally admitted, broken new ground and opened new ways and new outlooks. Nobody before him had so clearly shown the role of the productive agencies in historical evolution; nobody so masterfully exhibited their great determining influence on the forms and ideologies of social organisms. The passages and chapters dealing with this subject form, notwithstanding occasional exaggerations, the crowning parts of his works. If he has been justly compared with Darwin, it is in these respects that he ranks with that great genius, not through his value theory, ingenious though it be. With the great theorist of biological transformation he had also in common the indefatigable way in which he made painstaking studies of the minutest details connected with his researches. In the same year as Darwin's epoch-making work on the origin of species there appeared also Marx's work on the critique of political economy, where he explains in concise sentences in the preface that philosophy of history which has for the theory of the transformation or evolution of social organisms the same significance that the argument of Darwin had for the theory of the transformation of biological organisms."

45. The supreme importance of Marx and his colleague and life-long friend, Engels, lies in the fact that they were virtually the founders of modern Socialism and the Labor Movement, of which their writings are still the main inspiration, and that to them is due the ideology of the present regime in Soviet Russia. Emile Burns has recently edited a "Handbook of Marxism" (London, Victor Gollancz Ltd., 1935, 1,088 pp., 5/-); in this well-produced volume the most important writings of Marx and his followers are set out in full. The volume opens with the Communist Manifesto of 1848 and closes with the 1928 Programme of the Communist International; it shows Marxism over a period of 80 years and as still one of the most vital factors in politics.

46. Marx's anti-clericalism is best seen in his article on the Crimean War in the "New York Tribune" of 1854. Without compromising the question as to whether all Biosophers would or would not agree with all or the greater part of his views, I think Marx can be claimed as a Biosopher, although "Capital" is not a "Handbook of Biosophy."

47. *Herbert Spencer* (1820-1903) published between the years 1862 and 1896 a "*Synthetic Philosophy*" in ten volumes. He was an evolutionist even before the publication of Darwin's "Origin of Species" in 1859, and he coined the phrase "*survival of the fittest.*" In "*First Principles*" he says that Science and Religion must come to recognise as the "most certain of all facts that the Power which the Universe manifests to us is utterly inscrutable." Thus (quoting from an article on Spencer by Dr. F. C. S. Schiller), to be buried side by side in the Unknowable constitutes their final reconciliation, as it is the refutation of irreligion. Irreligion

consists of "a lurking doubt whether the Incomprehensible is really incomprehensible." Evolution is due to the "instability of the homogeneous." In "*Principles of Biology*" he develops his scheme of evolution; he admits the transmission of acquired characters. "*Principles of Psychology*" derives the working of the adult mind from that of a child and from our animal ancestors. In regard to his "*Principles of Sociology*" Spencer has been classed politically as an individualist of extreme *laissez faire* type. "*Principles of Ethics*" completes the Synthetic Philosophy.

49. Dr. Schiller sums up Spencer's position as follows:—"His heroic attempt at a synthesis of all scientific knowledge could not but fall short of its aim. Living at the commencement of an epoch of unparalleled scientific activity, Spencer could not possibly sum up and estimate its total production. To the specialists in sciences which were advancing rapidly and in divergent directions to results which often reacted on and transformed their initial assumptions, Spencer has often appeared too much of a philosopher and defective in specialist knowledge. To the technical philosophers, who strictly confine themselves to the logical collation and criticism of scientific methods, he has, contrariwise, not seemed philosophic enough. Hence his doctrines were open to damaging attacks from both sides. It seems unlikely, therefore, that as a system the *Synthetic Philosophy* will prove long-lived; but this hardly detracts from its fruitfulness as a source of suggestion, or from the historic influence of many of its conceptions on the culture of the age."

50. Spencer is a Biosopher, but his great work is too abstract and too cumbersome to approach the character of a "Handbook of Biosophy." It is not written for the "man in the street," and, so far as I remember, there is not a picture or diagram in all the ten volumes. Spencer is not a democrat, he writes for the elect.

51. No two men could differ more widely than the socially persecuted Communist, Marx, and the scientifically accepted individualist, Spencer, and if I am blamed for admitting either as a forerunner of Biosophy I would reply that the two are mutually complementary; Biosophy is neither Marxian nor Spencerian any more than it is Darwinian or Mendelian, Newtonian or Einsteinian; it looks for truth wherever the nearest approach is to be found. The Handbook of Biosophy I envisage is not a book written once for all by an author, but an institution constantly changing with the growth of knowledge and keeping pace with the hoped-for rationalisation of human conduct.

52. Biosophy, if it is destined to have any popular influence, will owe that, so far as Natural Science and Anti-clericalism are concerned, to the group of brilliant scientific men who, in the latter part of the nineteenth century, devoted most of their work to popularising evolution and spreading a scientific philosophy variously known as Agnosticism, Rationalism, and Scientific Materialism. Their activities coincided with the spread of public education and the establishment of "mechanics' institutes" and the like. Those of us who are old enough to remember the later of those days will recall the enthusiasm with which the new knowledge was received; perhaps it was only by a minority, but, nevertheless, a true age of reason appeared to be dawning for humanity. But a generation has passed and still the age of reason has not arrived; popular education not only made science available, it also let loose a flood of yellow journalism on the world; much as advance of technology has created fresh instruments of destruction for human life.

53. *John Tyndall* (1820-1893) was no less great for his physical discoveries than for his popular scientific expositions. His "*Belfast address*" to the British Association in 1874 will not be superseded for its concise and brilliant description of the early history of science and might with advantage be incorporated in the Handbook of Biosophy.

54. *Thomas Henry Huxley* (1825-1895) took, as a Biologist, the same place that Tyndall was taking as a Physicist. He was a great exponent of Darwinism and in his classic work, "*Man's Place in Nature*" (1863) brought the origin of man into the forefront of public interest.

55. On the Continent of Europe the equally distinguished biologist, *Ernst Haeckel*, popularised the new knowledge by a philosophical treatment of the biology of man and other animals under the title "*The Riddle of the Universe.*"

56. *Karl Pearson* in *The Grammar of Science* (1892) appears as a Biosopher. This is particularly true of the introductory chapter, of which the opening paragraph runs as follows:—"Within the past forty years so revolutionary a change has taken place in our appreciation of the essential facts in the growth of human society that it has become necessary not only to rewrite history, but to profoundly modify our theory of life and gradually, but none the less certainly, to adapt our conduct to the novel theory." "The slowness ought not to dishearten us, for one of the strongest factors of social stability is the inertness, nay, rather active hostility, with which human societies receive all new ideas."

57. "Modern Science," says Professor Pearson, "as training the mind to an exact and impartial analysis of facts is an education specially fitted to promote sound citizenship." "*There is no sphere of inquiry which lies outside the legitimate field of science.*" "The claims of science to our support depend on:—(a) The efficient mental training it provides for the citizen; (b) The light it brings to bear on many important social problems; (c) The increased comfort it adds to practical life; (d) The permanent gratification it yields to the aesthetic judgment."

58. Of the remaining nine chapters seven are devoted to mathematical and physical considerations of matter, motion, space and time, scientific law, etc., one to life and one to classification of the sciences.

59. Apart therefore from the very interesting introductory chapter and a brief treatment in the chapter on life, Professor Pearson does not carry on his survey into the domain of human sociology and politics.

60. Among the names I have mentioned, that of Marx, the least distinguished of them all in the field of pure science, stands alone in his living influence on the practical destiny of a large section of mankind. Biosophy needs its Marxes no less than it needs its Huxleys. Descriptive and historical science, without the driving force of politics and the revolutionary spirit, cannot ensure the betterment or even the safety of our civilisation.

CHAPTER I.—KNOWLEDGE AND THINGS KNOWN.

61. There are three levels of knowledge. The first level, that of everyday unspoken knowledge, man shares more or less completely with the higher animals; at this level we know our own personality and consciousness, with which is intimately connected our own body, and we are aware of various personalities and things around us; we learn by experience that we can act upon these personalities and things in various ways and that they can act on us. At this level of knowledge we take things for granted as being actually what they appear to be in the light of our sense impressions and our experience. At this level words do not come into the picture, but the self and the world of objects are none the less real for that; a child of eighteen months is at this level and such animals as dogs continue there throughout their lives. This is the field which had been expanding during fifty million years of the evolution of mammals and was derived from countless more distant years of earlier evolution. No matter that things were known through the medium of the unaided senses and through rough practical experience, it was and is a very real knowledge, it corresponded sufficiently with reality to enable man to live and reproduce and evolve.

62. The second level developed gradually in man with the growth of language and the growth of the brain mechanism associated with language. For the greater part the field of knowledge remains the same as at the first level. At first the difference between the second level and the first was chiefly a matter of the use of names; grass was called green, though the impression had been equally vivid and certain before the name came; a stone was hard, honey was sweet, food was desirable equally before the use of language as after. With the development of language and still more with the accumulation and transmission of knowledge which written records made possible, came further accession of facts, attempts at their logical classification and co-ordination, and great progress in the mechanical arts. The obvious aspect of space and time were noted and more or less accurate measurements made, and a valid science of mathematics was constructed. All this occurred in a few tens or hundreds of thousands of years preceding our present era, and progress was increasingly rapid in the last few thousands and few hundreds of years of that period. Still during that period the facts were of the same kind as those known at the first, speechless, or animal level, the facts which have to be known for survival in the animal struggle for existence; but they were more numerous, were recorded and measured, and applied in the mechanical arts. Language, in the period of the second level of knowledge, was of great service in recording facts and extending their knowledge and utility, but when it was used to discuss and explain them, and when it was attempted to penetrate below the surface of the world of the senses and experience without being possessed of appliances which gave fresh actual knowledge and a developed method of gaining that fresh knowledge, language became a dangerous weapon. Countless systems of mythology and philosophy and religion arose on the basis of attempts to get beyond the world of facts and commonsense by the use of words and by reasoning with words, and our world to-day is still permeated by the echoes of these old verbal disputes and imaginary systems. Interesting and important as is the history of early science and mathematics in Greece and in other old civilisations, I am unable to deal with it adequately, though a chapter should be given to it in the historical section of Biosophy.

63. No sharp line of division can be drawn between the second level of knowledge, in which the observations of commonsense were supplemented by speech and articulate reasoning, and the third level, in which instruments and appliances have been gradually introduced to amplify the power of the senses, in which measurements have been made with increasing accuracy, and in which a definite experimental system has been developed for checking and amplifying previous results. A transitional period extended from the Greeks through the Middle Ages, and the dominance of the third period may be taken roughly as commencing in the sixteenth century and as approaching full development at the present day.

64. The world of commonsense, of everyday experience, of ordinary language, of arithmetic and Euclid's geometry, is still the real, practical working world; although even for the working world science has given enormously increased understanding and increased power, through the microscope and telescope and physical and chemical discoveries of all kinds. But the new science is not destroying the old working world or making an illusion of it; on the contrary, it is explaining its nature by a continuous approach, at the third level of knowledge, to the "things in reality" of which the world is built up and to which the everyday properties of things are due. The mathematical relations of angles, sides and area of a triangle are none the less true and real because we cannot draw an infinitely thin and perfectly straight line. A perfect cylinder is impossible, but the motor mechanic can with no trouble rebore to an accuracy of 1/1000 inch, which is perfect for his purpose, and an accuracy of 1/100,000 inch could be obtained if there were need for it. By a machine 100,000 parallel lines to the inch can be ruled on glass with a diamond (Norbert's test for microscope lenses). A knife is none the less hard and sharp

because its sharpness is seen under a microscope to be a very clumsy attempt or because atomic physics teaches us that what appears to us solid iron is actually infinitesimal universes of whirling electrons in void space; the difference between a piece of iron, a piece of wood and a drop of water is none the less real because all can be analysed to such infinitesimal universes. The general working world of experience is not to be considered an illusion because the senses are imperfect and occasionally err even at the first level of knowledge, any more than because a flight of ducks can be deceived by a floating painted wooden model of a duck, or because a herd of game can be approached by a hunter decked with foliage. It is no more an illusion that a color appears to us as blue just because we now know the reality to be light of certain frequency, than it is an illusion when the Morse operator reads a paragraph of news from the dots and dashes of his instrument. Space, with its three dimensions of length, breadth and thickness, is none the less real because we now realise that we cannot define absolute position but only relative; we may be in a moving train, on a spinning earth circling the sun, within a moving universe, but the book we are reading has dimensions and a fixed position relative to our eyes and to all the objects in the train. Change of motion is no less real because it can only be determined in quantity and direction in relation to an arbitrary fixed point and not absolutely. Time, in the world of actuality, is a real and distinct one-dimensioned thing; it can no more be regarded in practice as a fourth dimension of space than a clock can be used conveniently and directly to measure a yard of cloth. [Relativity theories will, however, have to be considered in due course.] All these things of the world exist and function quite irrespective of whether I or you or any similar sentient being are there to perceive them; just as the radio waves are now all round us quite irrespective of whether we have a set in operation and are tuned in to receive signals.

65. Our knowledge of the world of reality is now not a superseding of the old but an enormously important amplification and extension. Not only is vision made more penetrating by the microscope and telescope, and touch and muscular sense more acute by delicate balances, but every phenomenon is studied from so many different angles by means of carefully planned experiments and apparatus that the "personal factor," so to speak, of our sense organs is practically eliminated. For example, sound and speech are recorded and studied on a gramophone disc or a sound track in a form quite independent of our ears. Photography and the cinema film have taken vision from the realm of metaphysics into the realm of actuality. The spectroscope and the refinements of modern chemical and electrical appliances are constantly approaching the nature of "things in reality" and eliminating the personal equation of the subject's psychology. Electrons, which thirty years ago were only a speculative probability, are now individually manifested in the spinthariscope and the cloud chamber and made to work for us all in the wireless valve.

66. In another field of knowledge the doctrine of organic evolution, especially the Darwinian theory of the origin of species by natural selection, has been of vital importance from its biosophic implications. In the first place it has rendered any such explanation as special creation unnecessary to account for the various forms of life. In the second place it has given us a much better alternative to the idea that the universe shows a benevolent design and a deliberate creation of conditions suitable to man, this better alternative being that life has itself evolved in the direction of adapting itself to and taking advantage of the conditions presenting themselves in the environment.

67. When it is remembered that the most important advances towards the knowledge of "things in reality" have been made within the last hundred years, an infinitesimal time on the geological scale, and that advance is now continuing at an unprecedented rate by the invention of new appliances and new methods of scientific research, it would be rash indeed to set limits to the possibilities of further advance. The "ignorabimus" of one generation may well give place to knowledge or expectation of knowledge in the next.

68. The prodigious growth and volume of detail has greatly altered the relation of the individual man to knowledge. To the savage of some thousands of years ago only a few human personalities, a few kinds of food animals and plants, a few simple tools, day and night and so on "mattered." Outside his immediate environment was nothing, and, within the limitation of his attainable knowledge level he knew personally most there was for him to know. For the student of 1500 A.D. a hundred books was a complete library. For the chemist of 1600 A.D. the body of chemical knowledge could be mastered personally in a few years. To-day a library may contain a million volumes, recognised animal species are in the neighborhood of a million, chemical compounds are numbered in thousands; in every field of knowledge even the specialist does not and cannot personally know more than a small corner. Apart from each man's small special fraction of a subject, knowledge now means increasingly knowing "where to look it up." Herein lies one of the differences between using education and wasting it; all people in civilised countries now are more or less educated, but some leave school or college with the faculty of following up a subject which interests them or which they make their work, whilst others go no further than absorbing the knowledge that is poured into them. In any branch of science it is no longer possible for an individual to repeat and verify personally all the experimental work on which his science is based; as a student he covers as much of this as he can, and if he continues professionally, his practical experience covers more and more thoroughly a narrower field; but everyone now has to trust to a considerable extent at second

hand to the published results of others; the nearer the connection between the work of these others and his own, the more critically he examines their conclusions and the more tendency he has to repeat and verify their experiments. Among scientific workers themselves, knowing as they do the records of their colleagues and the standards necessary for reliability, the results over the whole range of science are accepted with confidence, though always with the reservation that they may be and almost certainly will be extended or modified in the light of further research; there is thus a very large degree of unanimity in the territory covered by science, and when, in other territory, such unanimity is not found, it may be asserted with reasonable probability that scientific methods have not yet been sufficiently employed, and that their employment may be expected to clear up much of the confusion and discord which now prevails. The claim here made is that the scientific method is the only one capable of bringing enlightenment and that every aspect of knowledge including human relations is a proper subject for scientific treatment.

69. Knowledge, in the foregoing paragraphs, has been distinguished at three levels, roughly chronological, viz.: 1, the inarticulate animal level; 2, the older human level of speech and record; 3, the modern scientific level of organised observation and experiment. Knowledge at the third level (with some of its foundations at the second) may again be subdivided according to the nature or aspect of the things known. First we have the purely abstract science, A *Mathematics*, dealing with numbers and quantities and serving as a kind of universal language for the more concrete sciences; and, of lesser importance, is B *Logic*, defining the use of language in relation to the reality of things. Next we have a group of sciences graded in accordance with the scale and nature of the aggregation of the things dealt with; C. *Mechanics*, relating to matter in the mass; with this may be grouped *Physical Geography* and *Descriptive Astronomy;* D, *Molecular Physics*, relating to the motion of molecules; E *Chemistry*, relating to the combinations of atoms; F *Sub-atomic Physics*, relating to atomic structure, particles and radiation. As a special series of sciences, based on C, D, E, F, but distinguished by the high chemical complexity of the forms of matter studied, are G the *Life Sciences* (including Biology, Psychology, Ethics, Politics, etc.). Finally in H *History* is studied such knowledge as can be recovered with regard to changes which have occurred, particularly in the Earth and in the Evolution of Life and in Human Relations.

70. Knowledge, and the sciences which are the divisions of knowledge at its highest level, must be regarded as essentially "positive," using positive in the sense of true, as opposed to "negative" or false. But it must not be forgotteen that in most, perhaps all, branches of knowledge perfection has not been obtained. The most we can hope in each case is that the positive factors are in the majority and that they are being constantly increased in number, and that the negative factors are in the minority and are being constantly eliminated. Where is negative knowledge to be placed in a scheme of classification of the sciences? The aim of each science being to increase positive and eliminate negative knowledge, the general answer is quite clear, viz., that error once recognised has no part in current Science and becomes relegated to History. But there are qualifications. The senses are imperfect through the limitations of our sense organs and the physiological processes on which their working is based; illusions can therefore occur; I do not think these illusions are of such importance as is often claimed, for practical purposes our senses are wonderfully efficient, and the laboratory demonstration of illusions is often staged much as a conjuror stages his tricks, whereas the accidental staging of illusions is not a common occurrence in nature. These errors of the senses, which can still be staged for us, even though we know the impressions are erroneous and know the reason of the illusions, are not negative knowledge; rather their appreciation and explanation are positive knowledge and they are therefore properly included in the sciences of Physiology and Psychology.

71. Apart from sense illusion, which has just been excluded for reasons given, negative knowledge has no place in the first or animal level of knowledge. It was at the second, or human speech level, that negative knowledge became an important feature in the form of errors, falsehoods, and delusions, in part the result of carelessness of speech and thought, in part originating in deliberate falsification. The progress from animal to human level was mixed with much that was the reverse of progress. No animal approaches the wisdom of man, but none approaches man's folly. And man's folly still continues; although science is eliminating it among a minority, it still plays a most important part in the lives of the majority. Therefore, in saying that error once recognised has no part in current Science and becomes relegated to History, it must be admitted that this is to take a somewhat optimistic view, but a view which may, I think, be justified. The period during which science has been sufficiently advanced to dominate the thought, even of a minority, has been so short that, although the public has already welcomed and adopted the technical inventions of science, it has not yet approached the application of scientific principles in the conduct of life. We may therefore relegate to History error recognised by the scientific minority, and it may, I think, be justifiable to treat the supernatural, and supernatural religions, as historical, and not as a branch of current science, even though these still influence the thoughts and lives of a majority in a certain but rapidly diminishing degree. Human History will consist, to a very considerable extent, in the history of negative knowledge, and of the folly and injustice for which negative knowledge has been responsible.

CHAPTER II.—LIFE AS A FUNCTION OF CHEMICAL COMPLEXITY.

72. The point of view here taken is that there is a general unity underlying the phenomena of Nature, and that Life is a function of Molecular Complexity. The old barriers between man and the lower animals, and between the organic and inorganic, have long been broken down by science, and similar barriers between mind and body, and between living and lifeless, are equally destined to fall.

73. In studying the range of living things, and whatever character we take as a criterion, we can trace an endless succession of intermediate forms, from higher to lower, without any sharp line of division. Going still further, we know of ultra-microscopic forms of life, such as the germ of yellow fever, whose presence can only be inferred from its chemical infective activity, and whose diameter cannot well exceed some 20 times that of a simple protein molecule. In such an organism the processes of evolution are at a low level, and it no doubt remains much as its ancestors were myriads of generations ago, whereas in higher types, even with long intervals from generation to generation, great changes occur in relatively short periods of geological time.

74. Whilst recent discoveries have shown lower and lower types of organisms, at the same time physiologists have increased the definiteness of their knowledge of such complex chemical relationships as that of enzyme to food-stuff, or toxin to anti-toxin, and, by producing complexes of amino-acids, they are approaching the synthesis of protein.

75. The suggestiveness of these things is emphasised by the familiar facts of embryology, whereby a simple cell, the fertilised ovum, develops steadily and without break of continuity into man with all his attributes. It is plain that this simple cell carries the potentiality of the body with all its members, culminating in the marvellously complex central nervous system, and that it carries also the germ of consciousness; which grows to the fully developed human personality.

76. Embryology, palaeontology, and the study of inheritance, unite in showing the descent of all living organisms from a primitive protozoan ancestry (comparable to the fertilised ovum), and there is every probability that such descent may be traced still further through lower organisms like the ultra- microscopic germs before mentioned, to what we should at present call "inorganic matter."

77. We thus come to the converse conclusion that inorganic matter has inherent properties capable, under suitable physical conditions and with sufficient time allowance, of developing all the phenomena of life.

78. To each of us the most real thing is his own consciousness or personality. We attribute to other human beings consciousness like our own, and we cannot well refuse to allow such consciousness at lower and lower levels till we finally reach the chemist's atom and the physicist's sub-atom or electron.

79. It may be of interest to place here some notes on atoms, molecules, etc., compiled when the rough draft of this chapter was made over twenty years ago; more recent researches, whilst adding enormously to our knowledge, have rather tended to strengthen the case for continuity between living and "lifeless" matter. . . Present views on atomic physics and chemistry will be dealt with in later chapters of this work.

80. *The Ether.* Chemists and physicists have given very different views, and its nature (or even existence) is almost entirely hypothetical. Lord Kelvin constructed a gyrostatic model of the Ether. Larmor considered it as a fluid endowed with rotational elasticity, in which the "electrons" or sub-atoms of matter, exist as nuclei of strain. J. C. Vogt published in 1891 a "Simplified Conception of Substance," which was of considerable interest. According to Vogt there is a simple primitive substance, which fills space in unbroken continuity. Infinitesimal centres of condensation in this substance are the atoms ("pycnatoms") which have sensation and inclination—souls in a certain sense (compare Empedocles' love and hatred of the elements). These positive centres of condensation exceed the mean consistency and form ponderable matter. The intermediate substance, which negatively falls below the mean consistency is "Ether" or imponderable matter. The positive matter with its feeling of like or desire is continually striving to complete the process of condensation. The negative matter offers perpetual resistance to this condensation because of the further increase of its strain and because of the feeling of dislike connected therewith. There is no such thing as empty space, nor action at a distance through empty space.

81. *Sub-atoms.* Here we are on firmer ground; the electrons, corpuscles or sub-atoms of negative electricity can actually be detected and measured. They occur in radio-activity, with a velocity approaching that of light, and in the cathode rays with a lower velocity. Each carries (or is?) a unit charge of negative electricity (the same as the charge of an atom of hydrogen); their apparent mass is usually about 1/1000 of the hydrogen atom, but varies with the velocity. The corpuscles are identical, whatever their source.

82. *Atoms.* J. J. Thomson regarded each atom as a planetary system of corpuscles (negative) rotating in concentric rings or shells within a sphere (or, as Nicholson supposed, about a central nucleus) of positive electricity. The main mass of the atom is due to this positive sphere (or nucleus). Chemical valency depends on the readiness with which such a system, from considerations of stability, gains or loses a corpuscle or corpuscles. The atom of carbon may consist of four subsidiary systems arranged in the form of a tetrahedron. Wilson considered the number of corpuscles to average eight times the atomic weight. Nicholson regarded all elementary atoms as made up of one or more of four primary substances or "protyles," each of which is a system of electrons with a positive nucleus. Hydrogen is one of these protyles and the others were supposed to have atomic weights of .5, 1.6, and 2.4. Kleeman

found that atoms are approximately spherical, and their density increases with atomic weight, that of lead being about 14 times that of hydrogen, and a hydrogen atom being about 30 times denser than an electron.

83. *Molecules*, according to Kleeman, tend to be much flattened spheroids, the flatness increasing with increasing molecular weight. Simple gaseous molecules, such as CO2, have a diameter of about 1/3000 micron, and in gases at normal temperatures are about 1/400 micron apart. A proteid molecule with 2,300 atoms might have a diameter of some 1/200 micron, and in the collodial condition proteid is probably an aggregation of such masses. The limit of microscopic visibility is about 1/6 micron: the organism of cattle pleuropneumonia has about this diameter; but invisible forms are known, such as the yellow fever organism, which cannot well exceed 1/10 micron.

8. *Protoplasm.* Armstrong, as a result of his studies in enzyme action, regarded the protoplasmic complex as built up of a series of associated templates, which serve as patterns to determine change in the various directions necessary for the maintenance of vital processes and of growth. Similar ideas were expressed by Ehrlich, who regarded the photoplasm molecule as composed of a central executive group and a series of side chains or "receptors," which latter fit the food particles, enzymes, etc., in the way a key fits its lock.

85. A multicellular animal, from the point of view I am taking, may be regarded, in respect of a great part of its essential living structure, as a single gigantic chemical molecule, but as containing within that structure numbers of more or less independent molecules. For example, in man, I should regard the whole central nervous system as part of this molecule, at any rate so far as a linking in the form of chemical linking extends, and I do not know to what extent such linking may extend beyond the boundary of the central nervous system proper through the nerves, nerve connections, muscular system and sense organs. At the other extreme blood corpuscles may be taken definitely as independent molecules contained within the main complex.

86. The places in the universe in which a high degree of chemical complexity and life in its developed form are possible are, relatively speaking, extremely few and far between. In the stars, for the most part, simple chemical compounds cannot exist, and in the hottest stars even atoms are to a large extent dissociated. At lower temperatures chemical compounds become possible, but very seldom could the precise conditions occur, such as are found on the earth's surface, favoring the development of life as we know it. No doubt life as we know it has evolved to suit the earth's environment; but granting that organic evolution could occur under different, perhaps widely different, conditions, even then the spots where such might conceivably take place must be exceptional to an extreme degree. Apart from the doubtful exception of a few neighboring planets, no possible abode of developed life exists within a distance from the earth which it would take a ray of light, travelling 300,000 kilometres per second, over four years to penetrate.

87. The characteristics of living matter have been summed up as *adaptation*, or, as Herbert Spencer defined it "the continuous adjustment of internal relations to external relations." These characteristics include assimilation, respiration, energy discharge, growth, reproduction, and death. Organisation is one of the distinctive features of living beings.

88. The proposition that life is a function of molecular complexity is, in the light of recent advances in bio-chemistry, almost a truism, and I do not think that many biologists would dispute it in that form. But when one goes further and suggests that there is, in the structure of certain elements, most of them of low atomic weight, and particularly in carbon atoms, a potentiality capable of bringing about, in suitable conditions, the development of organisms recognisable as "living," then one can only say that the suggestion appears the most reasonable working hypothesis at present available. But, to establish the suggestion as something more than a working hypothesis, more solid support is necessary. It is well within the bounds of probability that such support may at any time be forthcoming; for all I know research in this direction may already be progressing. It will be no surprise if bio-chemists succeed within the next hundred years in synthesising a low form of living protoplasm; although, no doubt, the approach to such a synthesis will be long and tedious. The progress in the past hundred years has been sufficient to justify such a forecast.

89. It is no exaggeration to say that biologists now accept with absolute conviction the theory that since pre-Cambrian times, some thousand million years ago, lowly forms of life, probably unicellular Protozoa and Protophyta, the only forms of life then existing, and of microscopic dimensions, have by a process of evolution, by inheritance and variation and without external influence other than an environment roughly corresponding to the environment we now experience, given rise to all the forms of plants and animals now living, man included. The establishment of this theory has been the work of science in little more than the last hundred years, and is a more astounding achievement than would be the establishment of a similar and preceding evolution from carbon compounds to "living" protoplasm.

90. Equally striking is the evidence to be found in the development of each human being in his or her own life from the minute fertilised ovum to the adult form, for here every successive stage can be seen and examined in minute detail under the microscope. The range of evolution thus recapitulated in the individual human being is surely comparable in extent to the range of evolution postulated in this chapter between carbon compounds and protoplasm.

91. The difference in time scale is enormous, between the slow evolution by which, in the course of countless generations the pre-Cambrian protozoon gave rise to modern man, and the rapid individual develop-

ment by which, in the course of a few months, the fertilised human ovum becomes a recognisable human being; but the ovum has behind it that long evolutionary chain, on which no doubt it is dependent for its potentiality to develop. Students of genetics, with their observations of inheritance and chromosome structure and of experimental embryology, are already beginning to approach some of the problems connected with evolution and development.

CHAPTER III.—CONSCIOUSNESS AS A FUNCTION OF CHEMICAL COMPLEXITY.

92. The various sciences consist to a large extent of an analysis of things into their component parts. In Biology one analyses the organism into its constituent cells; and within the cells one deals with the molecular complex of protoplasm and with organic and inorganic molecules of various characters. Inorganic chemistry takes the analysis further to the level of the atom; and still below this one has now been taught to regard the atom as a small universe of electrons of negative electricity revolving round a positively electric nucleus. But there is one thing in particular, viz., consciousness, which eludes this analytical treatment and which appears to be a relation of the whole as contrasted to its parts—the one as opposed to the many.

93. In the chemical aggregation of matter from the simple to the complex there is an expansion of something over and above the aggregated particles, so that, in a sense, the whole is greater than the sum of its parts. It is this something which appears at the highest level known to us as our own personality or consciousness.

94. Seeing that all recent progress in science has tended to prove with greater and greater certainty the evolution of all organisms from an extremely low and primitive type, and also to prove the origin of all matter from one or a few kinds of elementary particles; so I think we have every expectation of success if we attempt to derive our own consciousness by a process of evolution from some primitive property associated with the mode of arrangement of the elementary particles of matter.

95. The suggestion I offer is that consciousness is a property connected with chemical organisation, a property of the whole of which the electrons are the parts. One might, perhaps, picture it as residing in or being the hypothetical aether of the physicist, and might picture units of consciousness of varying sizes and qualities, each of which units would correspond to a molecular grouping. In the physical conditions of high temperature obtaining in the hottest stars, where even electronic groups are to a large extent dissociated, the units of consciousness would be of infinitesimal size and of lowest quality. As atomic and molecular groupings become possible, so the corresponding units of consciousness become larger and more complex. In the gigantic molecular aggregation which forms the central essential living part of one of the higher animals, the unit of consciousness attains its maximum of size and complexity, the process culminating in man. To continue our picture in terms of ether and electron; the chemical, physical and mechanical processes of our body may be regarded as manifestations of a gigantic molecular aggregation, consisting essentially of chemically combined electrons, and "living" by reason of its incessant chemical and physical reactions and interchanges with its environment; and our consciousness may be regarded as the manifestation of the aetherial unit related to and entangled with the living electronic mechanism of the body.

96. From Biology we know that the embryonic development of an organism recapitulates more or less accurately the evolutionary history of its race. We see the unicellular ovum developing into a highly specialised vertebrate, and this helps us to realise the development of vertebrates from a unicellular ancestor. We must postulate in the ovum the germ of that consciousness which we find fully developed in the adult, and must further postulate such a germ of consciousness in the primitive ancestral forms of life.

97. All parts of the human body are not equal in importance as the seat of consciousness. Whole members—such as arms and legs—can be removed without much effect on the individuality. One could further imagine that the organs of circulation and nutrition could largely be replaced by artificial mechanical and chemical system. It is obviously in the nervous system that consciousness is most manifest.

98. The picture I have in mind is that whereas in primitive forms of life the chemical molecular grouping is relatively uniform and stable and the life process relatively generalised and the accompanying consciousness stable and of low order; in higher forms of life the chemical molecular grouping fluctuates more widely and the organism is a colony of gigantic chemical groups, some more or less closely linked with the central mass, others more or less unlinked chemically, the life processes are specialised, and the accompanying central mass of consciousness is ever fluctuating in proportion to subsidiary and more or less individual masses of consciousness within the organism.

99. In ourselves, in sleep or under an anaesthetic, the central consciousness can disappear, though the functions of life continue; the condition may best be visualised as a temporary interruption of the chemical linkings, having the effect of diminishing the central mass of consciousness and lowering its quality by reason of absence of the normal relationship with outlying masses and the temporary cessation of chemical and physical interchanges between the corresponding central and peripheral electronic mechanisms.

100. Like the organism consciousness appears to be the product of evolutionary growth from time immemorial. The organism is derived by heredity through an endless ancestral chain, and though it has an endless past the individual has a strictly finite future absolutely limited to a few days or years; so, too, the individual human consciousness presupposes an infinite

past and a finite future. The organism dies and the work of millions of years is ended as though it had never been, although the material components are unchanged in quantity and are ready to enter into the constitution of fresh compounds or fresh organisms, and the consciousness, broken into a multitude of low level units is ready to combine to higher levels pari passu with fresh combinations of the electronic mechanism.

101. Speculation as to the nature of consciousness is not metaphysical, it is legitimate and necessary. There are two things in the universe of which we have knowledge—consciousness and the electron—and of these our knowledge of consciousness is the clearer.

102. Whatever picture we may form in our minds as to the precise relationship between matter, life and consciousness it appears to me absolutely certain that life and consciousness are qualitatively and quantitatively related to and dependent on the degree attained of molecular chemical complexity; that in the absence of high chemical complexity life and consciousness of a high order do not and cannot exist; and that in the whole of the universe there is no possibility of a grade of consciousness approaching that of man, with the very doubtful exception of a few neighboring planets or of worlds at such inconceivable distance that no influence whatever could reach our earth. In the case of the great majority of the celestial bodies, we have direct evidence that the temperature conditions negative the possibility of even the simplest chemical combination.

103. The conception of the universe at which we arrive is accordingly that there are two factors; firstly *matter*, which is in the form of separate particles—the electrons; secondly *consciousness* (? compare ether), which is indefinitely extended, but which is localised in some manner into individualities each of which is intimately related to a particular molecular complex or material organism. The conditions obtaining in different parts of the universe are very varied; but for the most part molecular aggregation and therefore consciousness is at a very low level. The conditions on our own planet are exceptional, and man's personality is by far the highest of which we have any evidence, and the highest that can exist within a distance which is great even on an astronomical scale. The study of evolution, however, convinces us that there are possibilities in the future of man evolving to a type as far above the present, as regards both bodily frame and conscious personality, as existing man is above his pre-human ancestors.

104. If consciousness is regarded as the property of an ether-like medium, it is only in presence of an electronic mechanism that it becomes active, and the quantity and quality of each mass of consciousness must be regarded as corresponding to the extent and complexity of the molecular grouping to which it is related; only through its related electronic mechanism can it act or be acted on; where electronic mechanism is lacking, as in empty space, consciousness is absent. As molecular groups combine, break up and re-arrange themselves, so the related individual consciousness would extend, diminish or become modified.

105. The obvious relation in the higher animals between consciousness and the central nervous system has led some zoologists to regard consciousness as confined to animals with a well-developed central nervous system. That is not the view here taken, which is that consciousness at a lower level is present in all forms of life, but that in course of evolution specialisation has taken place among the various tissues and organs; so that while in primitive forms all the functions of life are evenly balanced in a single cell or in one or two simple tissues, in higher forms consciousness is developed to its highest level in the central nervous system, just as the kidneys concentrate on excretion and the lungs on respiration.

106. There is one point I wish to make clear; the question as to whether the seat of consciousness is in an ether-like medium, as here suggested, or in the electronic mechanism, is relatively doubtful and not of practical importance; the essential thing claimed is that consciousness is a function of chemical complexity, and that this is so I feel convinced so strongly as to regard the proposition as a truism. The implications of this proposition, if accepted, are of the greatest practical importance to mankind, for they make the survival of human personality after death and the existence of anything in the nature of a god a sheer impossibility. The abandoning of belief in God and of life after death is no loss to man; on the contrary, it will enable him to visualise, free of illusion and distraction, the possibilities of life on earth, and to devote his energy to realising these possibilities. Is there not enough mystery and beauty in the real universe and in life? and has man gained anything by pursuing the phantoms and delusions of supernatural religion?

107. The problem of the relationship of mind to matter has always been one of the chief features of the various philosophical systems which have from time to time gained credence, and it will be interesting to consider briefly the views of some of the philosophers.

108. *Empedocles*, one of the earliest of the Greek philosophers, having been born early in the 5th century B.C., held views which were naturally crude owing to the absence of systematic science. He originated the conception of four primary elements, earth, air, fire and water, which indeed are still popularly spoken of as the elements. Empedocles considered that all things are various minglings of these four. He further considered —and this is the interesting point—that the mingling of the elements is due to a desire or love between them, and conversely that separation of the elements is due to hatred. Love is therefore the formative principle and hate the destructive. In this ancient view of the loves and hatreds of the elements we have an idea which has long been lost sight of, but which may be recognised in some modern theories of matter.

109. *Democritus*, who was born B.C. 460, originated the theory of atoms, which in modern times received scientific confirmation at the hands of Dalton in the

early years of the 19th century. Democritus affirmed the multiplicity of elements, and considered that the atoms in themselves have no sensible quality, but that qualities are phenomena due to the *arrangement* of atoms.

110. In these two ancient views of Empedocles and Democritus we have a crude, though rational, view of the universe, a view free from mysticism or supernatural bias; but it seems to me that the same cannot be said for the systems of some of the later and more celebrated Greek philosophers whom I now proceed to mention.

111. *Plato*, who lived from B.C. 430 to 347, believed in two co-existent worlds. His first world is the *real* or *ideal* world, the world of existence, in which abstract ideas are the only realities and the only basis of science or philosophy. His second world is the world of *sense*—of *matter*—or of *phenomena*, and is the subject matter of sensation and opinion.

112. *Aristotle*, who was born B.C. 384, is considered the greatest intellect of antiquity, and his range of sound scientific knowledge was enormous; it is therefore rather disappointing that his view of the universe does not give us much help in the present enquiry. Aristotle held that matter exists in a three-fold form. He distinguished—Firstly:—*God*, who as an absolute unmoved eternal substance is thought. Secondly:—the *higher substance*, which, though perceived by the senses, is imperishable; he gives the heavenly bodies as examples of the higher substance. Thirdly:—the *lower substance*, perceptible by the senses, which is finite and perishable.

113. The *Stoic Philosophers* held the following views:—"There are two elements in nature. The first is 'hule prote' or primordial matter, the passive element from which things are formed. The second is the active element which forms things out of matter: reason—destiny 'heimarmene'—God. The divine reason, operating upon matter, bestows upon it the laws which govern it, laws which the Stoics called 'logoi spermatikoi' or productive causes. God is the reason of the world." (Lewes, p. 243.)

114. The only other ancient philosophy I need here mention is that of the *Neo-Platonists* of Alexandria, which is interesting, not so much for scientific soundness, but because it introduces three conceptions, viz.:—*God as Trinity*, the mystic *Word* "logos," and the idea of creation by *Emanation*, which formed the basis of Christian philosophy. Neo-Platonism began with Philo, who was born a few years before Christ, and ended with Proclus, who was born A.D. 412. The Alexandrian Trinity of the Neo-Platonists included the three following "hypostases" of God:—

A. "To hen haploun," the *one in all*, the perfect principle which generates but is ungenerated. By "emanation" (1) generates (2), i.e. (2) is the "logos" or word of (1).

B. "Nous"—*intelligence*, pure thought abstracted from all thinking. By "emanation" (2) generates (3), i.e. (3) is the "logos" or word of (2).

C. "Psyche"—the *soul of the world*.

God, as unity, *is not* existence, but he *becomes* existence by emanation of "Nous," and again of "psyche," and this "psyche," in its manifestations, is the world.

115. *Descartes*, who lived from 1596 to 1649, and was one of the great founders of modern science and philosophy, held an interesting opinion on the subject of consciousness, which he considered as peculiar to man, and as forming a rigid partition between man and brute. According to him the human soul is a thinking immaterial being completely distinct from the body, which is extended and material. Nevertheless, the soul is united to the body at a particular point, the pineal gland of the brain. It is difficult to be sure that Descartes was absolutely sincere in his statement regarding the soul, because his was an age of much religious persecution, and it would have been a dangerous heresy to compare the soul of man to that of animals. As Haeckel points out there is a good deal of inconsistency in Descartes' views, which may be considered monistic as regards animals, dualistic as regards man.

116. *Du Bois Raymond*, in his famous "ignorabimus" speech delivered at Leipsig in 1872, on the "Limits of Natural Science," treated consciousness as an insoluble problem, and as being opposed to the other functions of the brain as a supernatural phenomenon. He stated that there are two insoluble enigmas; firstly:—the connection of matter and force and their distinctive character; secondly:—the problem of consciousness—the question how our mental activity is to be explained by material conditions, how the substance which underlies matter and force comes, under certain conditions, to feel, to desire and to think. He suggests, however, tentatively that these two great world enigmas may be two aspects of one and the same problem.

117. *Haeckel* in "The Riddle of the Universe," published in 1899, devotes a great deal of attention to the subject of consciousness. This book is intended by Haeckel to demonstrate his monistic system of philosophy and is very well worth reading. He appears, however, inconsistent with his monistic principles in his view of consciousness. He separates the idea of the soul from that of consciousness; and whereas he allows soul to the protozoa and to all cells, and speaks of cell-souls, tissue-souls and nerve-souls in the higher animals, he denies consciousness to the lower invertebrates. He says, "Personally I take that theory to be most probable which holds the centralisation of the nervous system to be a condition of consciousness. . . . The presence of a central nervous system, highly-developed sense-organs, and an elaborate association of groups of presentations, seem to me to be required before the unity of consciousness is possible."

NOTE ON THEORIES OF THE CONSTITUTION OF MATTER.

118. The following note on the various older theories of the Constitution of Matter is adopted from an appendix by Professor Flint, D.D., to Tait's "*Properties of Matter*" (1894). Recent theories and discoveries will be referred to in a later chapter of this Outline.

A. All material substances are *infinitely divisible* into parts of the same nature as themselves and as complex, even as to qualities, as themselves.

B. All material substances are divisible into ultimate *indivisible* parts as complex as the whole.
One or other of these two theories (it is, perhaps, impossible to determine which) is attributed by Lucretius to *Anaxagoras* (about B.C. 500-428), whose real opinion, however, was probably the one which follows.

C. All material substances are formed from a primitive matter, "in which all things were together, infinitely numerous, infinitely little," and of which each infinitely little part was infinitely complex.

D. All material substances result from the combination of a few kinds of material elements (e.g., the "Four Elements," earth, water, air, fire), each of which is composed of particles like to itself, e.g., earth of earthy particles, air of aerial particles.
This was the theory of the Hindu, *Kanada*, the Greek *Empedocles* (about B.C. 490-430), and a host of medieval *physicists*.

E. All material substances are states or stages of one primitive matter or element, e.g., of water or air.—The theory of *Thales* (B.C. 640-546), *Anaximenes* (fl. about B.C. 550), etc.

F. All material substances are divisible into ultimate indivisible parts, "*Atoms*," "strong in solid singleness," which have no qualitative but only quantitative differences, and which variously come together through motion in a void. This is the atomic theory as taught by *Democritus* (about B.C. 460-340), *Epicurus* (B.C. 342-270), etc.

G. All material substances are divisible into molecules and ultimately into elementary atoms (of over 70 kinds) possessed of distinctive qualitative as well as quantitative differences.—The atomic theory of nineteenth century chemistry.

H. All material substances are divisible into so-called "atoms," but these are complicated structures consisting of congregations of truly elementary particles, identical in nature and differing only in position, arrangement, motion, etc., and the chemical "atoms" are produced from the physical "particles" by processes of evolution.—Theory of *Herbert Spencer* (1820-1903), etc., which gained ground during the nineteenth century, and, towards the end, began to receive experimental confirmation.

I. All material substances are composed of atoms, not hard and solid and on that account indivisible, but the rotatory rings or infinitesimal whorls of an incompressible frictionless fluid (the "ether"), supposed to be homogeneous and perfect, but the nature of which is not otherwise described; and all the differences of material substances are due to the characters and behaviours of their component rings or whorls.—*Lord Kelvin's* (1824-1907) Vortex Atomic Theory.

J. The matter which is the object of the senses is the product of a world-building power moulding in accordance with eternal ideas an uncreated substratum, the "receptacle" and "nurse" of "forms," but itself devoid of form and definite attributes.—Theory of *Plato* (B.C. 430-347).

K. The matter which is an object of sense is a synthesis of *form* with a *primary* matter which is merely capacity and passivity—a synthesis produced by a formative cause, which must be both an efficient and final cause.—Theory of *Aristotle* (B.C. 384-322).

L. Impenetrability (by which I take Prof. Flint to mean that space actually occupied by one ultimate particle of matter cannot at the same moment be occupied by another) is the essence of matter.—Theory of various physicists.

M. Extension (meaning *volume*, or bulk) is the essence of matter. "Give me extension and motion and I will construct the world."—*Descartes* (A.D. 1596-1649).

N. Material things are "modes" of extension, which is one of the only two discoverable "attributes" of the one "substance."—*Spinoza* (1632-1677).

O. Matter in its ultimate constitution consists of *metaphysical points* which give rise to sensible matter by states of effort transitional from rest to motion.—*Vico* (1668-1744).

P. The ultimate elements of matter are indivisible points without extension but surrounded by spheres of attractive and repulsive force which alternate according to the distance of these points up to a certain degree of remoteness.—*Boscovich* (1711?-1787).

Q. The physical universe is constituted by the unconscious perceptions of a vast collection of unextended spiritual forces or monads, endowed with a power of spontaneous development and with something of the nature of desire and sentiment; and the properties which physical science ascribes to the ultimate elements of matter are the modes under which the reciprocal actions of the monads appear to sense.—*Leibnitz* (1616-1716).

R. Matter is a mental picture in which "mind-stuff" is the thing represented, and mind-stuff is constituted by feelings which can exist by themselves, without forming parts of a consciousness, but which are also woven into the complex form of human minds.—*Clifford* (1845-1879).

S. Matter apart from perception has no existence; physical phenomena are essentially *sensations* or *ideas;* "bodies" are groups or clusters of actual or expected sensations arranged according to so-called

laws of nature in which is manifest the working of the Divine Mind.—*Berkeley* (1685-1753).

T. Matter is simply an appearance to sense, without anything real in it.—The Hindu theory of Maya, the Eleatic Philosophers' theory of non-being, etc.

U. Matter is "the permanent possibility of sensations." —*J. S. Mill* (1806-1873).

V. "Matter is that whereby *Will*, which constitutes the inner reality of things, becomes perceptible or manifest. In this sense Matter is thus merely the manifestation of Will, or the bond between the *World as Will* and the *World as Idea*. Matter is throughout Causality."—*Schopenhauer* (1788-1860).

W. Matter is constituted by forces which are outgoings or manifestations of the Divine Will.

X. Matter is not objectified Will but objectified Thought.

Y. Matter is Nature's self-externality in its most universal form with a tendency to self-internality or individuation shown in the force of gravitation, and nature is the Idea in the form of otherness, or self-alienation.—*Hegel* (1770-1831).

RELATION OF THE WHOLE TO ITS PARTS.

119. Difficult as is the problem of consciousness, science has at any rate to some extent defined the nature of the problem. By emphasising the extreme loneliness and isolation of man in the universe it has done away with a number of vague speculations regarding extraneous spiritual and supernatural consciousnesses and possibilities of such being concerned in the genesis of human consciousness, speculations which otherwise might have continued to obscure the subject; it has shown that the only hope of solution, if solution is possible, lies in laboratory methods in physics, chemistry and psychology.

120. Consciousness appears to be a unifying principle, a relation of the whole to its parts, and, as such, some light may in the future be thrown on it by study of the way in which qualities of chemical compounds are related to those of their constituents. Nothing could be more surprising than the difference which exists between the qualities of such a substance as water and the hydrogen and oxygen of which it is composed, or a host of other compounds which could be mentioned, unless the fact that the various qualities of elementary substances themselves depend on the mere numbers and geometrical arrangements of two or three kinds of primordial particles be considered even more surprising. Both in regard to atomic and molecular organisation we have the clearest evidence that the whole is a very different thing from the sum of its parts: and herein may lie one way of approach to the problem of life and consciousness. Merely mechanical aggregation introduces no such difference of qualities; a nebula, a sun or a planet (the latter apart from living organisms which may be present) is no more than the sum of its constituent materials, although, of course, these materials may themselves be of a certain low order of chemical complexity and their qualities may thus be a few steps removed from those of simple atoms or particles. This discrepancy between the whole and the sum of its parts reaches its climax in our own personalities.

121. Looking outside our own personalities we are convinced of the presence of similar qualities in other human beings, and I think we cannot deny very similar qualities to mammals, birds, many reptiles, insects, molluscs and other animals. In the highest of these we can almost recognise ourselves, except for rational speech. Allowing for anatomical differences, when we watch a cat or a dog, or a bird, or even a bee, a hermit-crab, or an octopus, the difference between any of them and ourselves is only one of degree and proportion. As we pass down in the scale of life recognition becomes more difficult; but there is no hard and fast line, so that we can say "this side is consciousness, the other is none." Still lower in the scale, how are we to recognise consciousness? Even if it is there, and I believe it is, the conditions and organisation of the lowest animals and plants are too far from our own to make it immediately recognisable by us. We know for a certain fact that the fertilised human ovum grows into the full human personality; at no stage in this growth is there a division line between consciousness and its absence. The male and female germ cells in plants, such as ferns and cycads, clearly indicate common origin with animals; nowhere can a sharp line of division between conscious and unconscious be drawn. But we cannot *recognise* consciousness in the lowest forms; that does not mean it is absent, but only that the organisation is not there to present it in the form we know in ourselves. If this line of argument is valid, and I think it is, we have to look for germs of consciousness, in the lowest forms of life and in "lifeless" matter, from a very different standpoint from that of human psychology. Starting from the top we have to work from human psychology downwards; starting from the bottom we have to work from the changes of qualities with atomic and molecular organisation upwards. Can these two lines of work be made to meet?

THE FREQUENCY RATE OF CONSCIOUSNESS.

122. What is the highest rate of change by which states of consciousness succeed one another? Some information on this can be obtained by the process of counting. We can count aloud four or five figures per second, so long as small, easily spoken numbers go; here evidently the speed of nerve conduction (about 28 metres per second) between brain and speech organs, and time-lag in the nerve endings has to be taken into account. If we count mentally we can increase to six to eight figures to the second, counting, so to speak, in mental "ticks" instead of mental "figures." The extreme limit of mental successions appears to be about ten to the second.

123. Flicker on rotating black and white discs disappears at ten to the second with weak, and fifty to the

second with strong, illumination. A light impression lasts on the retina from 1/30th to 1/50th second. On this depends the possibility of the cinema. The truly conscious visual changes seem not to exceed about ten to the second, the flicker phenomena between 10 and 50 to the second being a sort of borderland or semi-consciousness.

124. As to sound, there seems to be considerable difference between individuals; the number of vibrations at which distinctly perceived sounds merge into musical tones varies from 15 to 30 vibrations per second. Here again the distinct consciousness effect appears to be in the neighborhood of ten to the second, with a semi-consciousness borderland of 15 to 30 vibrations per second [I find a reference by Starling, "according to Exner, two sounds following one another are perceived as distinct if the interval between them is not less than 0.002 second." This introduces a contradiction which needs consideration.]

125. The vibrations of musical tones (30 per second to 30,000 per second) do not cause corresponding "vibrations" of consciousness, they cause resonance of mechanical parts of our ear which reaches the consciousness as sensation of tone; similarly the much higher frequencies of visible light cause resonance in retinal structures which reaches the consciousness as color.

126. The limit of frequency at which we can "count" or transmit distinct impulses has been estimated above at ten to the second. The vibration frequency of insect wings is much higher than this; that of the wasp being estimated at 110, and that of the house fly at 330, and no doubt that of the smaller gnats may reach 660. This implies corresponding vibration frequencies of consciousness in these insects. As regards the meaning of "now" in consciousness I have somewhere seen this estimated (I think by J. B. S. Haldane) as approximately two seconds; about this interval of time represents for us the *present*, as distinguished from *past* and *future*.

127. The conclusion may be drawn that, under the damping influence of the great molecular complex associated therewith, human consciousness has a "vibration" frequency of 1/10th second; that the corresponding "vibration" frequency of small, but still highly organised, insects is 1/100 to 1/600 second; and that the "vibration" frequency of the rudimentary "consciousness" of still more minute organisms may perhaps be exceedingly rapid.

CHAPTER IV.—ELIMINATION OF THE SUPERNATURAL.

128. For this chapter I have chosen as subject the growth of the popular rationalist and anti-clerical movement from the time of the Renaissance onwards, and I illustrate this movement by a somewhat full reference to a small number of those writers who, by their importance and the readableness of their books, still make a personal appeal to us. By thus limiting myself I am omitting all reference to early Science and Philosophy in Greek and Roman times, and the origin and history of the Christian and other Religions. I also omit here reference to what is perhaps the most important—and the most interesting—historic aspect of Rationalism, viz., the growth of actual Science and its conflicts with the Church, associated with such names as Copernicus, Galileo, Vesalius, Harvey, Newton, Hutton, Dalton, Darwin, Huxley, Tyndall, and a host of others down to the present day.

BOCCACCIO.

129. *Giovanni Boccaccio* (1313-1375) was not over fond of the clerics of his day, and in one of his famous stories from the Decameron, the *Story of the Three Rings*, is to be found one of the earliest expressions of *"Free Thought."* The story may be summarised as follows:—

130. "The Emperor Saladin, having exhausted his treasury by wars and liberality, and needing money, bethought him of a rich Jew, by name Melchisedech, a money-lender of Alexandria, who had the means to serve him, but was notorious for his avarice. Saladin, therefore, sought some means of forcing him to disgorge; so he called him, received him familiarly, and said, 'Worthy Sir, I have heard from many people that you are most wise in the things of God, and I would know of you which of the three religions you consider the true one—the Jewish, the Moslem, or the Christian?' The Jew, who was in truth a wise man, saw that Saladin intended to trap him—whichever of the three he chose—and replied, 'My Lord, the question is a fair one, and to explain what I feel I will tell you a little story.

131. "'There was once a man—great and rich—whose dearest possession was a ring—so precious and beautiful, that in order to leave it forever as an heirloom to his descendants, he ordained that to whichever of his sons this ring should come, he should be the heir and be honored and revered by the others. By a like ordinance the ring descended generation after generation, and at last came to the hands of one who possessed three sons—all equally excellent and equally beloved of their father; and each asked the father for the ring. The old man having privately promised it to each, and being unable to come to a choice, and wishing to satisfy all, secretly called a jeweller and had two more rings made, so exactly like the original that even the jeweller could not distinguish them. Before his death the old man secretly gave each of his sons a ring; and when he died each son came forward claiming the inheritance, and producing his ring in evidence. And so alike were the rings that it was impossible to decide which was the heir, and the question remains unsettled to this day. And so I say, my Lord, of the three creeds given by God the Father to the three peoples you ask of, each thinks he has the true one—but as to who really has it, the question, like that of the three rings, is still unanswered.'" Saladin, appreciating the Jew's shrewdness, then frankly explained his former intentions, and asked Melchisédech's assistance. The Jew freely served him, and was afterwards well repaid, with handsome gifts in addition. And Saladin always gave him friendship and maintained him near him in great and honorable estate.

THE DEISTS.

132. *Deism* was the first definitely expressed and organised form of religious free-thought. Lord Herbert of Cherbury (1583-1648) is known as the "Father of Deism," and Charles Blount (1659-1693) inaugurated one of its characteristic features—the critical examination of Old and New Testaments. Deism was most conspicuous in England between 1680 and 1750. Deists held to the certainty and sufficiency of Natural Religion in opposition to "Revealed" Religions, and considered the first cause of the Universe to be a personal God who is, however, not only distinct from the world but apart from it and its concerns.

133. David Hume (1711-1776) has been classed both as a Deist and a Sceptic. As a Deist he gives expression to the "argument from design" thus:—

134. "The whole frame of nature bespeaks an intelligent author; and no rational enquirer can after serious reflection suspend his belief a moment with regard to the primary principles of genuine Theism and Religion."

135. Again:—"All things in the universe are evidently of a piece. Everything is adjusted to everything. One design prevails throughout the whole. And this uniformity leads the mind to acknowledge one author; because the conception of different authors, without any distinction of attributes or operations, serves only to give perplexity to the imagination without bestowing any satisfaction on the understanding."

136. Hume thus accepts the two fundamental conclusions of the argument from design: (i) a Deity exists, (ii) he possesses attributes allied to human intelligence. But Hume appears as a Sceptic in the following paragraph:—

137. "The whole is a riddle, an enigma, an inexplicable mystery. Doubt, uncertainty, suspense of judgment, appear the only result of our most accurate scrutiny. But such is the frailty of human reason, and such the irresistible contagion of opinion, that even this deliberate doubt could scarcely be upheld; did we not enlarge our view, and opposing one species of superstition to another, set them a quarrelling; while we ourselves, during their fury and contention, happily make our escape into the calm, though obscure, regions of philosophy." Hume heartily disliked all professors of dogmatic theology.

138. At the time of the American War of Independence the leading American statesmen, Benjamin Franklin, Tom Paine, Washington and Jefferson, were Deists; Deism was also the creed of the American Quakers.

139. Tom Paine (1737-1809), Secretary of Foreign Affairs to the American Congress, was author of "Common Sense," "Rights of Man" and "Age of Reason." In his dedication of the last work, "to my fellow citizens of U.S.A." (American edition, 1794), he says, "The most formidable weapon against error of every kind is Reason. I have never used any other, and I trust I never shall." In the first chapter he gives his profession of faith as follows:—

140. "I believe in one God, and no more, and I hope for happiness beyond this life.

141. "I believe in the equality of man, and I believe that religious duties consist in doing justice, loving mercy, and endeavoring to make our fellow creatures happy.

142. "But, lest it should be supposed that I believe many other things in addition to these, I shall in the progress of this work declare the things I do not believe, and my reasons for not believing them.

143. "I do not believe in the creed professed by the Jewish Church, by the Roman Church, by the Greek Church, by the Turkish Church, by the Protestant Church, nor by any Church that I know of. My own mind is my own Church.

144. "All national institutions of Churches, whether Jewish, Christian or Turkish, appear to me no other than human institutions, set up to terrify and enslave mankind, and monopolise power and profit. . . .

145. "Infidelity does not consist in believing or in disbelief; it consists in professing to believe what a man does not believe."

146. I give here a short extract from his criticism of the New Testament as an example of his style of treatment.

147. "Christ's Historians—having brought him into the world in a supernatural manner, were obliged to take him out again in the same manner. The first part —that of the miraculous conception—was not a thing that admitted of publicity; and therefore the telling of this part of the story had this advantage, that though they might not be credited, they would not be detected. They could not be expected to prove it, because it was not one of those things that admitted of proof, and it was impossible that the person of whom it was told could prove it himself.

148. "But the resurrection of a dead person from the grave, and his ascension through the air, is a thing very different, as to the evidence it admits of, to the invisible conception of a child in the womb. The resurrection and ascension, supposing them to have taken place, admitted of public and ocular demonstration, like that of the ascension of a balloon, or the sun at noonday, to all Jerusalem at least. A thing which everybody is required to believe requires that the proof and evidence of it should be equal to all, and universal. . . .

149. "Instead of this a small number of persons, not more than 8 or 9, are introduced as proxies for the whole world, to say they saw it, and all the rest of the world are called upon to believe it. But it appears that Thomas did not believe the resurrection . . . *so neither will I;* and the reason is equally as good for me as for Thomas."

WINWOOD READE.

150. I now come to one of the most remarkable men associated with the Rationalist movement.

151. *William Winwood Reade* (1838-1875) contrived in his short life of 37 years to undergo remarkable adventures as an African explorer, and, besides his other literary works wrote "The Martyrdom of Man," which, from its first issue in 1872, has year by year won increasing popularity and reputation. In 1903 this book had already reached its 17th edition, and there have since appeared several others as well as cheap reprints.

152. Winwood Reade was of a good Oxfordshire family, and was a nephew of the great novelist, Charles Reade. He was educated at Winchester and Oxford, and early showed a taste for science, which for a time he deserted in an unsuccessful attempt to follow his uncle's example as a novelist.

153. Subsequently (says the Dictionary of National Biography) Mr. Du Chaillu's theories, published in 1861, respecting the power and aggressive character of the gorilla so inflamed Reade's curiosity that, having raised money on his inheritance, he started for Gaboon to ascertain the truth, and after five months of hunting, during which time he ascended the river higher than any of his predecessors, discovered its rapids and visited the cannibal races, he was finally able to demonstrate to scientific men that the gorilla is an exceedingly timorous animal, almost inaccessible to European sportsmen in the thick jungles which it inhabits. He then visited Angola in south-western Africa, and afterwards ascended the Casemanche, Gambia and Senegal, seeing something of Moslem life among the negroes, and also of the wild tawny Moors.

154. In these travels be became conscious of his ignorance, and after his return to England he recommenced the study of science. He entered as a student at St. Mary's Hospital, and in 1866 volunteered his services for the cholera hospital at Southampton. In 1869 he revisited the African Continent under the auspices of the Royal Geographical Society, Mr. Andrew Swanzy, a well-known merchant on the Gold Coast, providing the means. His first object was to open up the Assinie river, and to go as far as Coomassie, but the Ashantees prevented him. He then proceeded to Sierra Leone, and thence started to explore the sources of the Niger. He reached Faluba, where he was detained for three months in honorable captivity, and then sent back. Still undaunted, he started again, and this time he was allowed to pass. He succeeded in reaching the Niger, but as the source was inaccessible owing to native wars, he went to the gold mines of Bowri, a country never previously visited by a European.

155. In November, 1873, he returned to Africa as special correspondent of the "Times" during the Ashantee war, and fought at the battle of Amoaful in the ranks of the 42nd Highlanders. From this third expedition to Africa he returned quite broken down in health, and he died in 24th April, 1875.

156. His uncle, Charles Reade, in an obituary notice ("Daily Telegraph," 27th April, 1875) observed that "the writer thus cut off in his prime entered life with excellent prospects; he was heir to considerable estates, and gifted with genius. But he did not live long enough to inherit the one or to mature the other. His whole public career embraced but fifteen years; yet in another fifteen he would probably have won a great name and cured himself, as many thinking men have done, of certain obnoxious opinions which laid him open to reasonable censure."

157. Benn, in his "History of English Rationalism in the 19th Century," refers to Winwood Reade as "The stormy petrel of the advancing hurricane . . . . a writer more truly symptomatic of the new era—a writer in whom the daring of what he said counted for incomparably more than the power—although that was not small—with which he said it."

158. "The Martyrdom of Man," published in 1872, is a sketch of universal history, with particular reference to religions. The "martyrdom of man" consists in renouncing for truth's sake the "sweet and charming illusion" of the immortality of the soul. "Christianity is not only false but a superstition and ought to be destroyed." "God-worship is idolatry. Prayer is useless. The soul is not immortal. There are no rewards and punishments in a future state."

159. "The Supreme Power," says Reade," is not a Mind but something higher than a Mind; not a Force, but something higher than a Force; not a Being, but something higher than a Being; something for which we have no words, something for which we have no ideas." "It is an unknown God, supreme and mysterious." Yet we know that it exists, that by it the universe has been created; that it is One; that prayer to it would be profanity.

160. Reade says, some persons argue, "that it is impossible to attack Christianity without also attacking all that is good, all that is pure, all that is lovely in human nature. When you travelled in Africa (they say) did you not join in the sacrifices of the pagans? . . . and since you could be so tolerant to savages surely you are bound to be more tolerant still to those who belong to your own race, to those who possess a nobler religion . . . To this I reply that the religion of the Africans, whether pagan or Moslem, is suited to their intellects, and is therefore a true religion; and the same may be said of Christianity amongst uneducated people. But Christianity is not in accordance with the cultivated mind; it can only be accepted, or rather retained, by suppressing doubts, and by denouncing inquiry as sinful. It is therefore a superstition, and ought to be destroyed. With respect to the services which it once rendered to civilisation, I cheerfully acknowledge them, but the same argument might once have been advanced in favor of the oracle at Delphi, without which there would have been no Greek culture, and therefore no Christianity. The question is not whether Christianity assisted the civilisation of our ancestors, but whether it is now assisting our own. I am firmly persuaded that whatever

is injurious to the intellect is also injurious to moral life; and on this conviction I base my conduct with respect to Christianity. That religion is pernicious to the intellect; it demands that the reason shall be sacrificed upon the altar; it orders civilised men to believe in the legends of a savage race. It places a hideous image, covered with dirt and blood in the Holy of Holies; it rends the sacred veil of Truth in twain. It teaches that the Creator of the Universe, that sublime, that inscrutable power, exhibited his back to Moses, and ordered Hosea to commit adultery, and Ezekiel to eat dung. There is no need to say anything more. Such a religion is blasphemous and foul. Let those admire it who are able. I, for my part, feel it my duty to set free from its chains as many as I can. . . . There has been enough of writing by implication and by innuendo; I do not believe in its utility, and I do not approve of its disguise. There should be no deceit in matters of religion. In my future assaults on Christianity I shall use the clearest language that I am able to command."

161. "We do not wish to extirpate religion from the life of man; we wish him to have a religion which will harmonise with his intellect, and which inquiry will strengthen, not destroy. We wish, in fact, to give him a religion, for now there are many who have none. We teach that there is a God, but not a God of the anthropoid variety . . . God is so great that he does not deign to have personal relations with us human atoms. Those who desire to worship their Creator must worship him through mankind. . . . To develop to the utmost our genius and our love, that is the only true religion. To do that which deserves to be written, to write that which deserves to be read, to tend the sick, to comfort the sorrowful, to animate the weary, to keep the temple of the body pure, to cherish the divinity within us, to be faithful to the intellect, to educate those powers which have been entrusted to our charge, and to employ them in the service of humanity, that is all that we can do. Then: our elements shall be dispersed and all is at an end. All is at an end for the unit, all is at an end for the atom, all is at an end for the speck of flesh and blood with the little spark of instinct which it calls its mind, but all is not at an end for the actual Man, the true Being, the glorious One. We teach that the soul is immortal; we teach that there is a future life; we teach that there is a Heaven in the ages far away; but not for us single corpuscles, not for us dots of animated jelly, but for the One of whom we are the elements, and who, though we perish, never dies, but grows from period to period, and by the united efforts of single molecules called men, or of those cell-groups called nations is raised towards the divine power which he will finally attain. . . . A day will come when the European God of the nineteenth century will be classed with the gods of Olympus and the Nile . . . when nurses will relate to children the legends of the Christian mythology as they now tell them fairy tales. A day will come when the current belief in property after death (for is not existence property, and the dearest property of all?) will be accounted a strange and selfish idea. . . .

162. "You blessed ones who shall inherit that future age of which we can only dream; you pure and radiant beings who shall succeed us on the earth; when you turn back your eyes on us poor savages . ... remember that it is to us you owe the foundation of your happiness and grandeur, to us who now in our libraries and laboratories and star-towers and dissecting-rooms and workshops are preparing the materials of the human growth. And as for ourselves (all we have) we owe to the labors of other men. Let us, therefore, remember them with gratitude; let us follow their glorious example by adding something new to the knowledge of mankind; let us pay to the future the debt which we owe to the past. All men, indeed, cannot be poets, inventors, or philanthropists; but all men can join in that gigantic and god-like work, the progress of creation. . . . He who strives to subdue his evil passions—vile remnants of the old four-footed life—and who cultivates the social affections . . . whatever may be his motives, he will not have lived in vain. But if he act thus not from mere prudence, not in the vain hope of being rewarded in another world, but from a pure sense of duty, as a citizen of Nature, as a patriot of the planet on which he dwells, then our philosophy which once appeared to him so cold and cheerless will become a religion of the heart, and will elevate him to the skies. . . .

163. "I give to universal history a strange but true title—*the Martyrdom of Man.* In each generation the human race has been tortured that their children might profit by their woes. Our own prosperity is founded on the agonies of the past. Is it therefore unjust that we also should suffer for the benefit of those who are to come? Famine, pestilence, and war are no longer essential for the advancement of the human race. But a season of mental anguish is at hand, and through this we must pass in order that our posterity may rise. The Soul must be sacrificed; the hope in immortality must die. A sweet and charming illusion must be taken from the human race, as youth and beauty vanish never to return."

THOMAS HENRY HUXLEY (1824-1895).

164. I conclude these extracts by quoting the last three paragraphs of Huxley's brief Autobiography, which was prefaced to an edition of his Lectures and Essays, and which well expresses the attitude of Biosophy towards Supernatural Religion.

165. "The last thing that it would be proper for me to do would be to speak of the work of my life, or to say at the end of the day whether I think I have earned my wages or not. Men are said to be partial judges of themselves. Young men may be; I doubt if old men are. Life seems terribly foreshortened as they look back, and the mountain they set themselves to climb in youth turns out to be a mere spur of immeasurably higher ranges, when, with failing breath, they reach the top. But if I may speak of the objects I have had more or less definitely in view since I began the ascent of my hillock, they are briefly these: To promote the increase of natural knowledge and to forward the applica-

tion of scientific methods of investigation to all the problems of life to the best of my ability, in the conviction which has grown with my growth and strengthened with my strength, that there is no alleviation for the sufferings of mankind except veracity of thought and of action, and the resolute facing of the world as it is when the garment of make-belief by which pious hands have hidden its uglier features is stripped off."

166. "It is with this intent that I have subordinated any reasonable, or unreasonable, ambition for scientific fame, which I may have permitted myself to entertain, to other ends; to the popularisation of science; to the development and organisation of scientific education; to the endless series of battles and skirmishes over evolution; and to untiring opposition to that ecclesiastical spirit, that clericalism, which in England, as everywhere else, and to whatever denomination it may belong, is the deadly enemy of science."

167. "In striving for the attainment of these objects, I have been but one among many, and I shall be well content to be remembered, or even not remembered, as such. Circumstances, among which I am proud to reckon the devoted kindness of many friends, have led to my occupation of various prominent positions, among which the Presidency of the Royal Society is the highest. It would be mock modesty on my part, with these and other scientific honors which have been bestowed upon me, to pretend that I have not succeeded in the career which I have followed, rather because I was driven into it than of my own free will; but I am afraid I should not count even these things as marks of success if I could not hope that I had somewhat helped that movement of opinion which has been called the New Reformation."

BIOSOPHY AND THE CHURCHES.

168. Biosophy is the only practicable religion for humanity:—not, of course, Biosophy as I am writing it, but as it should be and will be written and carried out, if life is to be worth living. It is in part founded on "Rationalism," but it has a wider scope because it accepts Art and appreciation of Beauty as equally important with Science and appreciation of Truth, and on these twin foundations it seeks to erect an ever-growing edifice of the highest happiness for man. As regards its foundations the great enemy of Biosophy is to be found in the Churches, and as regards its superstructure the great enemy is in Politics (which latter I am not now considering except in so far as Church and State are interwoven).

169. The Churches are essentially and without exception living lies. I admit that some can see good points in them, just as I admit that a surgeon can see a cancer as beautiful—a fine specimen for the museum or laboratory. So far as dogma is concerned, a Church nowadays may mean anything or nothing. Side by side, and all sheltered under the wing of Christianity, some churchmen preach the grossest superstitions as to heaven and hell and the sacrificial "blood of the lamb," others visionary and irresponsible doctrines of spiritual existence and hierarchies of angels, whilst still others have thrown over in succession chapter after chapter of the fundamental teachings of their historic Church until it is difficult to know if they have any creed left at all.

170. To churchmen of the last group Biosophy is a definite challenge. If they find they are in truth Biosophers and not Christians let them come out in the open and admit the fact. If they assert the right to select passages from the bible which they approve and reject those they disapprove, to throw revelation overboard and accept the conclusions of science, to modify their ethical code in accordance with the evolution of society and to deny any supernatural character to Jesus, then they are definitely not Christians but Humanists, who incorporate what is good in Christianity with what is good in other spheres of knowledge or conduct. If, besides this, their mind is open as to the question of a future life and they concentrate their efforts to making the best of the life we know, then they are definitely Biosophers, and cannot with honesty retain a common label identifying them with the devotees of superstition and falsehood, who are their and the Biosophers' worst enemies.

171. As regards congregations, I do not think that nowadays Christianity as a creed has very much hold on them. Church attendance is largely a matter of "esprit de corps," certain individuals or families have been in the habit of attending the services of a certain denomination, meeting their friends there, going to socials and picnics, working-bees and the like; they are friendly with the parson, and, to avoid "letting him down," turn up at church more or less frequently. Church gives a sort of insurance in the shape of christenings and confirmations, people don't really think the kiddies are any the safer for these, "still you never know, and it costs so little that you may as well be on the right side"; it also gives a little social eclat to weddings, "here comes the bride, all dressed in white" ("Lohengrin," via Zazu Pitts) is a very human touch, and the bridesmaids are lovely; a funeral service may be a pathetic tragedy or a melodramatic farce according to circumstances, in either case more or less understandable, though it was a parson and not a Biosopher who wrote those memorable lines: "Go, pop Sir Thomas again in the pond. Poor dear! he'll catch us some more."

172. Congregations nowadays do not total a very large percentage of the population, and yet census statistics still show an unexpectedly large proportion of adherents of the various denominations. The officer in charge of census collections is not very partial to Biosophers; he puts it to one that one is more or less expected to belong to a Christian denomination and gives one plenty of these to choose from; he generally gives

one the chance to be an atheist, but that is, by its associations, not a nice word; instead of implying that one has the best of constructive creeds it hints that one has not got something which normal people are expected to have; a man is almost as diffident of describing himself as an atheist as a eunuch; he is therefore apt to put down whatever denomination his parents belonged to and let it go at that. Nevertheless I think quite a large percentage of these people are really Biosophers if they only knew it: from the "religious" standpoint *Atheist* is the proper census description of a Biosopher.

173. At his best the man who makes his career in the Church is an intellectually ill-balanced saint, on average an unintelligent and not over-scrupulous parasite on the working population, at his worst a scheming and theatrical hypocrite responsible for some half of the major disasters of civilisation. How can rational behaviour be expected in a scientifically mechanised world where fundamentals of conduct are still, for the majority, based on a tissue of lies and absurdities?

174. Liberty of thought and belief is demanded by Biosophy and must be conceded to its opponents; but that liberty does not include justification for making material gain from trading in superstition. Modern legislation is prone to deal with such minor forms of charlatanry as palmistry and crystal gazing whilst leaving the great, organised and wealthy Churches untouched. It is finance and endowment that keeps supernatural religion alive; whilst a living and a career are open in the Churches, so long will the religious racket continue. I do not for a moment suggest that religion is the only racket; there are political, aristocratic, charitable and other rackets, and all will have to be considered in later chapters of this outline. Such slogans as "For God, King and Country" are the last resource of the united racketeers.

175. A sane Democracy has no need for rackets; charity will be superseded by publicly organised insurance and social services, and such window dressing activities as charity and social service on the part of the churches are rapidly becoming no less an anachronism than their supernatural doctrines.

176. The case of Biosophy against the churches may be summarised as follows:—

177. A. The supreme need of the world, in order to avoid chaos, is unity in intellectual honesty and clear thinking. The splitting of society in warring religious factions, warring over things that have no reality, prevents unity. Intellectual honesty and clear thinking are impossible so long as the falsehoods of religion are accepted as truths.

178. B. The fiction of a god or providence superintending human affairs confuses the essential importance of just and rational control. The fiction of a life after death palliates the existence of injustice in our actual life and diverts attention from the need to make the best of this life. The most anti-social conduct has been and is being excused on the pretext of acceptability to alleged but non-existent gods, and sacrifice of duty to and happiness in actual life extolled in the interest of an imaginary life after death.

179. C. The churches have always opposed the dissemination of scientific truth. Being themselves vested interests founded on falsehoods they stand by other vested interests founded on injustice; they thus act as a drag on political and economic reform. Commercial and financial interests have secured the progress of scientific technology; but the corresponding advance in scientific sociology, which was necessary to prevent abuse of technology, has failed to materialise, and for this failure the churches and the religious outlook in general have been responsible to a very large extent. In other words, the churches by maintaining an ideology which has no relation to reality have stood in the way of the development of an ideology capable of guiding the modern world.

180. By 1880 the intellectual battle between science and the churches was already won. Thinking people no doubt considered that it was only a matter of time before the victory of science was generally recognised and that the decision could safely be left to time; it was therefore "*good form*" not to discuss religious questions and not to attack the churches openly and explicitly. Science did not hasten to prosecute the victory which Huxley and his contemporaries had won. This attitude might have worked well enough under ordinary circumstances, and in time science would have been accepted as the guide to conduct; but unfortunately circumstances have not proved to be ordinary; the tempo of invention, of economic production, of finance and of political change became so speeded up after 1880 that chaos speedily overwhelmed the world, finding it intellectually and socially unprepared. Civilisation missed its chance in not actively continuing the work of Huxley at a speed corresponding to that of technological changes in production and communications. Millions of lives have been lost, hundreds of millions have suffered and many more are destined for murder and suffering before this leeway in ideology is regained.

The possibility of a god controlling or effectively acting in a world in which the greatest speed of communication is the velocity of light, and in which the average distance of one part from another is measured in hundreds of millions of light years, is no longer conceivable.

181. If any one cares to study the vagaries of revivalist Christianity he may find an example in Beverley Nichols' book, "The Fool Hath Said" (1936). Out of a miscellany of Bible, Biblical criticism, science, pacificism, symbolism and I know not what besides, the author concocts a journalistic exposition of the story of Beverley Nichols' fluctuating conviction of his salvation in Christianity. The second half of the book relates his experiences of the "Oxford Movement." The author quotes the first principles of the group as being "*Absolute honesty, absolute purity, absolute unselfishness and absolute love.*" But what on earth have these

to do with Christianity any more than with the rational ethics of any social reformer? Why abandon rational thought and why introduce the hysteria and emotionalism of the supernatural into the picture? Beverley Nichols is not behindhand in decrying Christianity when its hysteria takes the form of national patriotism; he should realise that supernaturalism and religious emotionalism are false guides and dangerous in all circumstances.

CHAPTER V.—SCALE IN NATURE.

182. In modern science accurate measurement is of ever-increasing importance, and the dimensions dealt with range from such extremes of inconceivable distance on the one hand to equally inconceivable minuteness on the other, that the choice of units and scales of measurement requires much consideration.

The Centimetre Unit.

183. Whatever measuring we may do we must have a unit to start from; the draper uses yards, the mechanic inches, the surveyor chains; but the measures which were in use in old days varied so much from country to country and from trade to trade, that their value in the international field of science was not great, and in most countries the international metric system is now compulsory even for commercial purposes; in the British Empire the metric system is a legalised optional alternative to our usual commercial standards. Of the various decimal or metric measures, each of which is a multiple by ten of another in the system, the centimetre is the one generally selected as the scientific unit. Roughly $2\frac{1}{2}$ centimetres make an inch (1 centimetre=0.3937 inch). In practice our metric measures are all derived as more or less accurate copies of a metre defined by two fine lines marked on a bar of iridio-platinum in the British Department of Standards; the centimetre, of course, being a hundredth part of this standard length.

Multiples and Fractions of the Centimetre.

184. When a scientific man is engaged on specialist work in which a rather limited range of dimensions is concerned, he often thinks and speaks in terms of some other unit within the metric system instead of in centimetres. For example, in radio he thinks of his wave lengths in metres (100 cm.); whilst a bacteriologist thinks of his "germs" in microns (1/10,000th cm.). Here, then, is one way of visualising and speaking of very large or small dimensions, viz., by using large units for the former and small units for the latter. The astronomer often uses as his unit the "light year," the distance which light travels in one year, which is about ten million million kilometres; the nearest star is over four "light years" away from us. To express such large dimensions as multiples of the centimetre would become increasingly cumbersome, and similarly to express the minute dimensions of atomic physics in decimals or fractions of the centimetre is almost equally cumbersome. The difficulty is accentuated when, as is often the case, very large and very small dimensions are included in the same paragraph, or in one mathematical formula or equation.

Orders of Magnitude.

185. The scientist avoids this difficulty, whilst retaining the centimetre unit for all measurements, by a very simple device. He expresses his figures in powers of ten; thus 1,000 is written 10^3, 1,000,000 is written 10^6; if the number were 1 with twenty-five noughts after it, he would write 10^{25}. In the same way small fractions or decimals are written with a minus index corresponding to the number of noughts in the fraction, or to the places of decimals. Thus 1/100,000,000th or .000,000,01 is written 10^{-8}. Three million is written 3×10^6, and the fraction, three millionths, or .000,003, is written 3×10^{-6}. If more precision is needed, decimals may be added after the first figure; thus three and a quarter millionths or .000,003,25 is written 3.25×10^{-6}. The saving of figures is not great when one is only dealing with millions, the last example using five figures as compared with eight in the decimal notation; but the saving is great when very large or very minute magnitudes are being considered.

A Scale to Represent Orders of Magnitude.

186. Usually, when we make use of a scale of any kind we consider equal divisions at one end of the scale as corresponding exactly to equal divisions at the other end. For example, a carpenter's rule is divided equally into inches and eighths; we apply it to a piece of wood and find the thickness to be $1\frac{1}{8}$ inch, and if we apply the rule to a piece twice as thick it would read $2\frac{1}{4}$ inches. In this case the actual reading of the scale corresponds precisely to the thickness of the wood. We may also use the carpenter's rule to draw a scale plan of a house, making $\frac{1}{8}$ inch on the rule correspond to one foot of the house; in other words, we are drawing a plan on the scale of $\frac{1}{8}$ inch to the foot, or of one to ninety-six. We may similarly make an enlarged drawing of minute detail seen under the microscope, on a scale, for example, of ninety-six to one. In each of these cases, once the proportion of our scale is fixed, we treat any equal division at one part of the scale as exactly equivalent to an equal division at another part.

187. The use of a scale in this way works well when we are dealing at one time with objects of the same order of magnitude. It is quite practicable to draw plans of a big house and a small house, both on a scale of $\frac{1}{8}$ inch to the foot, or half a dozen microscopic objects on a scale of 100 to one. But we cannot use a single scale in this way when we wish to compare objects bigger than houses with objects smaller than can be seen under the microscope.

188. The difficulty may be overcome by constructing a scale of orders of magnitude, as is shown in the accompanying diagram on page 66. Here the large divisions, alternately black and white, are all equal, so far as the actual drawing is concerned, just as the divisions on a carpenter's rule are all equal; but there resemblance ceases, and the "meanings" of the divisions are by no means

equal. On the contrary, every black or white division is to be understood as meaning ten times as great a dimension as the division immediately below it and a tenth of the dimension of the division immediately above it. By this device it is possible in a diagram only about ten inches long to place in their relative order, in terms of a unit of one centimere, all conceivable magnitudes from the limit of astronomical space down to the ultimate particles or wave-lengths of matter. Each of the large black or white divisions of the scale is an order of magnitude. Starting from the centimeter unit at about the lower third of the scale, 27 positive orders of magnitude stretch to the top of the scale, the 27th order representing the extreme limit of space; and 14 negative orders stretch to the bottom of the scale, the 14th negative order representing dimensions smaller than the ultimate particles of matter.

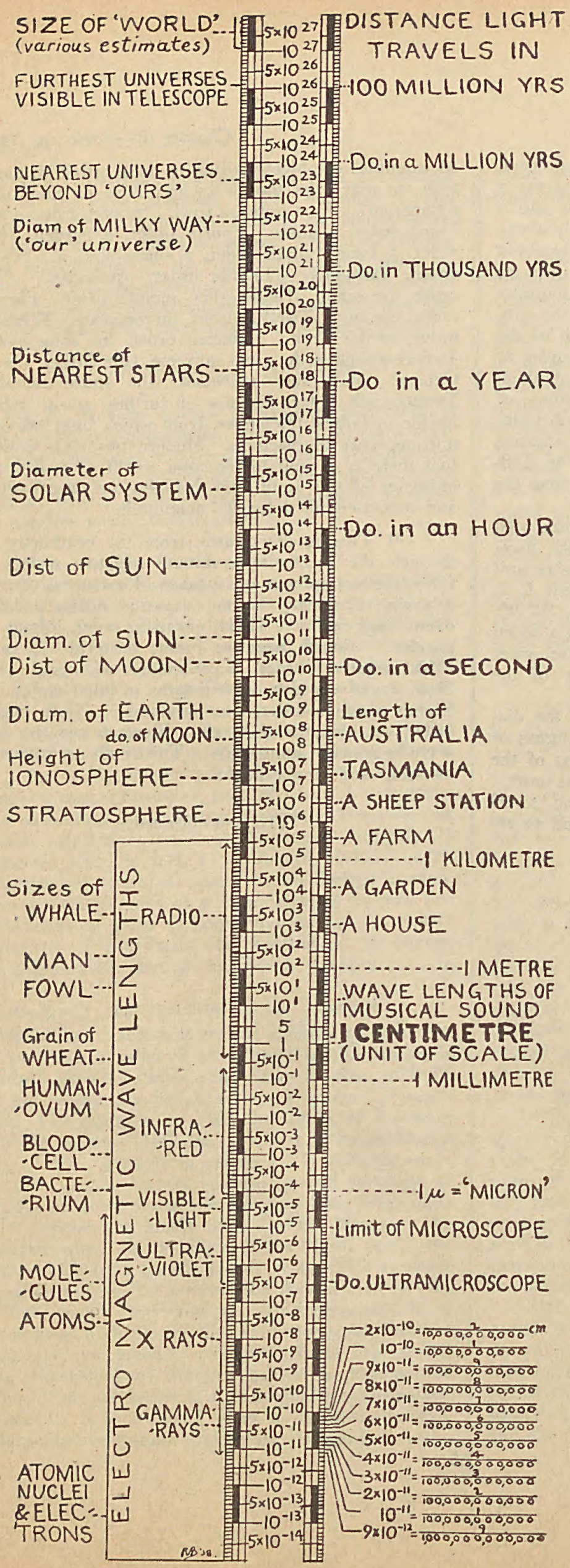
189. In order to represent every digit within each order, nine small divisions are marked on each main division of the scale. Starting from the centimetre unit these small divisions, reading upwards, represent 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 200 cm., and so on. The actual reading of a dozen of these small divisions about the 11th negative order are shown at the bottom right-hand corner of the diagram.

190. Looking at the dimensions shown in the diagram those of which the index (the right-hand figure or pair of figures) is 1 may be called dimensions of the first order of magnitude (on a centimetre basis as unity). The first order includes dimensions from 10 cm. to 99 cm.; the second order from 100 to 999 cm., and so on. As examples of objects falling in these orders of magnitude we may take the following: Zero or unit order, a fingernail. First order, a fowl. Second order, a man. Third order, a house. Fourth order, a garden. Fifth order, a farm. Sixth order, a sheep station. Seventh order, Tasmania. Eighth order, Australia. Ninth order, the earth. Tenth order, moon's orbit. Eleventh order, the sun. Twelfth order, largest stars. Thirteenth order, earth's orbit. Fifteenth order, the solar system. Twenty-second order, our universe (the Milky Way or Galaxy), and other universes (the spiral nebulae). Twenty-sixth order, distance of furthest spiral nebulae visible in largest telescopes, from which light takes 100 million years to reach us. Modern physicists consider that there is a limit to the total world of space; their estimates of this limit vary between the twenty-seventh and twenty-eighth orders of magnitude.

191. Passing downwards from the centimetre unit through the increasingly minute negative orders, the following examples may be taken: First negative order, a grain of wheat. Second negative order, a human ovum (egg-cell). Third negative order, blood corpuscles. Fourth negative order, bacteria ("germs"). Fifth negative order, wave-lengths of visible light. Sixth negative order, wave-lengths of ultra-violet light. Eighth negative order, size of atoms. Ninth negative order, wave-lengths of X-rays. Eleventh negative order, wave-lengths of Gamma rays. Thirteenth negative order, electrons and atomic nuclei.

(To be Continued.)

SCALE OF ORDERS OF MAGNITUDE



MEMOIRS OF THE KYANCUTTA MUSEUM.

No. 1.—NEW SPECIES OF ARCHAEOCYATHINAE AND OTHER ORGANISMS from the Lower Cambrian of Beltana, South Australia. By R. and W. R. Bedford. March, 1934. (pp. 8 and 6 plates, 4to.) Price, post free, Two Shillings.

No. 2.—FURTHER NOTES ON ARCHAEOCYATHI (Cyathospongia) AND OTHER ORGANISMS from the Lower Cambrian of Beltana, South Australia. By R. and W. R. Bedford. April, 1936. (pp. 11 and 14 plates, 4to). Price, post free, Four Shillings.

No. 3.—CYATHOSPONGIA (Archaeocyathi) AND OTHER ORGANISMS from the Lower Cambrian of Beltana, South Australia. By R. and J. Bedford. (pp. 6 and 6 plates, 4to.) Price, post free, Two Shillings.

No. 3a.—STRUCTURE AND CLASSIFICATION OF ARCHAEOS. A paper presented at the Auckland meeting of the Australian and New Zealand Association for the Advancement of Science. By R. and J. Bedford. Mimeographed copies (out of print).

No. 4.—FURTHER NOTES ON ARCHAEOS (Pleospongia) from the Lower Cambrian of South Australia. By R. and J. Bedford. September, 1937. (pp. 12 and 15 plates, 4to.) Price, post free, Four Shillings.

No. 5.—AN OUTLINE OF "BIOSOPHY." Part I. By R. Bedford. (pp. 27 and 1 plate, 4to.) Price, post free, One Shilling and Sixpence.

The Kyancutta Museum has for Sale and Exchange Duplicate Specimens of ARCHAEOCYATHI. Enquiries from Overseas Museums and Universities are invited.

E. J. McAlister & Co., Printers, 24 Blyth Street, Adelaide.